V. 2 is not available at the Record Center - CMK/6/9/09

RCRA Interim Status Closure/Post Closure Plans

Volume I

for

1198010003- Madison
Chemetco, Inc.
Route 3
Hartford, IL
ILD048843809

November 1998

RECEIVED
NOV 19 1998
IEPA-BOL
PERMIT SECTION

CSD

Environmental Services, Inc.
2220 Yale Boulevard
Springfield, IL 62703
(217) 522-4085

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

1021 North Grand Avenue East, P.O. Box 19276, Springfield, Illinois 62794-9276 Mary A. Gade, Director

217/782-5544
217/782-9143(TDD)

February 19, 1999

Mr. Patrick F. Keufler
Enforcement and Compliance Assurance Branch
Waste, Pesticides and Toxics Division
United States Environmental Protection Agency, Region 5
DE-9J
77 West Jackson Blvd.
Chicago, Illinois 60604-3590

Re: Chemetco

Dear Pat:

Enclosed for your information is a copy of a closure/post closure plan modification application submitted by Chemetco. It is currently under review. If you wish to submit any comments on this application, please send them to the permit reviewer, Kevin Lesko, of our RCRA permits unit.

Please feel free to call if you have any questions.

Sincerely,

Christopher P. Perzan
Assistant Counsel
Division of Legal Counsel

TABLE OF CONTENTS

LIST OF TABLES, FIGURES AND APPENDICES

1. INTRODUCTION

1.1 Purpose

This document presents revised closure and post-closure plans for five (5) historical solid waste management units at Chemetco, Incorporated ("Chemetco"), Hartford, Illinois. The location of all five waste management units is provided in Figure 3-1. The units which are being closed in accordance with RCRA closure requirements are as follows:

- zinc oxide bunker;
- former zinc oxide pile (the pile has been closed and was replaced by the bunker in 1984);
- zinc oxide lagoons (sometimes referred to as the "dirt pits");
- cooling water canal; and
- floor wash water impoundment (also referred to as the "acid pit").

Chemetco is pursuing classification of the bunker as a Corrective Action Management Unit (CAMU). The zinc oxide bunker will be closed pursuant to the landfill requirements of 35 Ill. Adm. Code Part 725.400.

Chemetco is not attempting "clean closure" of the other four (4) units. The floor wash impoundment will be closed without removal of its contents or residual materials. Final closure of these units is anticipated upon final plant closing.

In addition to the technical details of closure and post-closure care, this submission includes closure and post-closure cost estimates and a schedule under which Chemetco proposes to conduct closure activities. This plan has been developed in accordance with the Illinois Environmental Protection Agency ("IEPA" or "Agency") "Instructions for the Preparation of Closure Plans for Interim Status RCRA Hazardous Waste Facilities" dated December 11, 1990.

The Chemetco facility was constructed in 1969 and commenced production of anode copper, cathode copper, crude lead-tin solder, zinc oxide and slag in 1970. All units being closed in accordance with this closure/post-closure plan, with the exception of the floor wash water impoundment and the cooling canal, are associated with the historical management of zinc oxide. However, it is IEPA's opinion that zinc oxide was accumulated speculatively in lagoons and piles and thus require RCRA closure. When tested using the E.P. Toxicity method, greater than threshold levels of lead and cadmium were found in the zinc oxide. The material is not a listed waste, but it is hazardous on the basis of these characteristics.

This document is intended to fulfill the applicable regulatory requirements for hazardous waste pile and impoundment closure/post closure as set forth in 35 Ill. Adm. Code, Subtitle G, Parts 724 and 725. In addition, the document describes present groundwater monitoring activities related to closure of the facility as well as the on-site groundwater subsurface interceptor drainage system ("SIDS").

1.2 Scope of Work

This effort constitutes final closure of the Chemetco facility. The closure, and post-closure plans address the five (5) hazardous waste storage units located in four (4) distinct waste management areas.

Chemetco is pursuing classification of the zinc oxide bunker as a CAMU from USEPA in the form of a 3008(h) order to allow placement of remediation wastes from the following areas:

- zinc oxide spill
- non clean fill area
- slag fines
- sediment from the bottom of the open portion of the cooling canals.

At the time of approval from the USEPA on the CAMU designation, a revised closure plan will be submitted for the bunker expansion. The bunker will be closed as a landfill pursuant to 35 Ill. Adm. Code, Part 725.400

Materials were previously removed from the second and third and fourth units, the former pile, the lagoons and the cooling water canal. The Agency considers verification testing previously completed to confirm the adequacy of those efforts as insufficient to demonstrate clean closure. Chemetco is not pursuing "clean closure" of these units, rather they are requesting the IEPA to determine that the levels of contamination from the sources remaining on site are not significant and will deem these units closed, yet subject to post-closure monitoring.

The fifth unit, the floor wash water impoundment, has been associated with groundwater contamination and as such, is subject to closure requirements equivalent to those for an interim status landfill. Chemetco has previously demonstrated the lateral extent of this unit. Based upon the historical information developed, extent of the unit was determined and a cap designed. After plant closure, the cap will be constructed over the former impoundment.

The post-closure plan includes the appropriate inspection, maintenance and monitoring procedures associated with the closure of the former zinc oxide pile, zinc oxide bunker, zinc oxide lagoons, cooling water canal and floor wash water impoundment as landfills. Chemetco also will continue to operate groundwater control measures during the closure and post-closure periods and conduct monitoring to evaluate system performance. Details of the groundwater monitoring programs are found in Section 3. Through a series of discussions, Chemetco has agreed with the Agency to monitor both the shallow and regional aquifer as part of closure/post-closure.

1.3 Statement of Facility Status After Closure

Chemetco is not pursuing final closure at this time. Cap placement over the floor washwater impoundment will be completed upon shutdown of the plant. These actions will constitute final closure of the facility.

2. FACILITY DESCRIPTION

2.1 General

The Chemetco facility is located within a primarily agricultural, light residential area south of Hartford and is bounded on the west by major, heavily traveled rail and highway routes and on the south by a private secondary road. More specifically, the 40+ acre plant site is in the Southeast 1/4, Section 16, Township 4 North, Range 9 West of the Third Principal Meridian, in Madison County (see Figure 2-1). Chemetco's most recent Part A submission listed storage in a waste pile (S03) and three (3) surface impoundments (D83) as the waste management practices on site. This modified Part A application, which embodies agreements reached between Chemetco and IEPA, was submitted with the March 1993 RCRA Part B Post-Closure Application. Appendix 2-1 contains a copy of the Part A application. This revised Part A lists the following waste management practices:

- storage in a waste pile, S03, includes the zinc oxide bunker and former zinc oxide pile; and

- storage in a surface impoundment, D83, includes the floor wash water impoundment, zinc oxide lagoons and cooling water canal;

2.2 Waste Management Units Being Closed

This section lists and describes the waste management units being closed:

- former zinc oxide pile and present zinc oxide bunker (Units 1a and 1b, respectively);

- zinc oxide lagoons, or "dirt pits" (Unit 2);

- floor wash water impoundment or "acid pit" (Unit 3); and

- cooling water canal (Units 4).

The bunker and the remaining units, listed above and shown as Units 1 through 4 on Figure 3-1, are described in detail below.

2.2.1 Zinc Oxide Bunker

The zinc oxide bunker is listed on page 1, line 1 of the facility's revised Part A, Form 3. The unit, which is approximately 365 feet by 310 feet in dimension, has an estimated capacity of 3,000,000 gallons. The bunker was constructed in phases in 1984 to replace an on-ground zinc oxide pile of approximate dimensions 150 feet by 200 feet. The former pile was located on the same site as the current bunker. The bunker primarily contains approximately 40,000 tons of zinc oxide with lesser amounts of soil excavated during the closure of the former pile, zinc oxide lagoons and cooling canal, and a significant amount of slag (23,500 tons) used as a wind dispersal control measure on the north and west sides. Testing has shown the zinc oxide to be Extraction Procedure Toxic for lead.

2.2.2 Zinc Oxide Lagoons

The zinc oxide lagoons are listed on page 1, line 3 of the facility's revised Part A, Form 3. The two (2) lagoons, which together as one (1) unit encompassed an area approximately 150-feet by 220-feet and were 15-feet deep had an estimated total capacity of 890,000 gallons. Constructed in 1978, the unit was operated until 1984 to gravity separate and de-water zinc oxide prior to sale and shipment off-site as a product. To the best of Chemetco's knowledge the unit received only production zinc oxide during its operating life.

2.2.3 Cooling Water Canal

The cooling water canal is listed on page 1, line 4 of the facility's revised Part A, Form 3. The canal, which was approximately 30 feet wide by 3,600 feet long by 10 feet deep, had an estimated total capacity of 3,825,000 gallons. Exact construction date of the canal, which served as a source of non-contact cooling water for various plant equipment, is unknown. The canal was used until it was replaced with a cooling tower and closure began in 1985. The canal became subject to RCRA regulation only by virtue of a small (i.e., estimated at less that 2,500 pounds) spill of zinc oxide from the zinc oxide lagoons into the south leg of the canal.

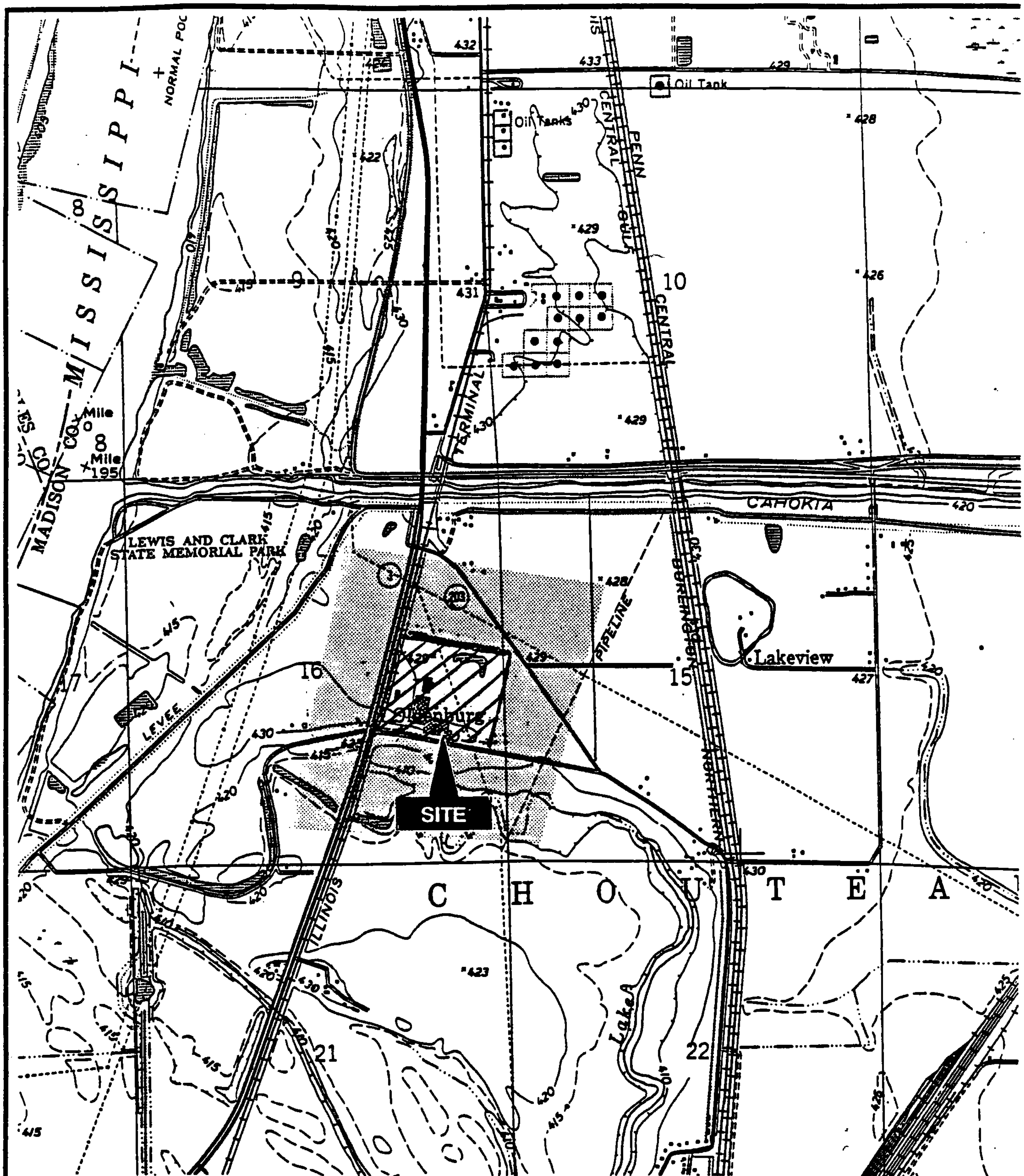
2.2.4 Floor Wash Water Impoundment

The floor wash water impoundment is listed on page 1, line 2 of the facility's revised Part A, Form 3. Many historical details of the unit, including exact construction date, capacity, and the date on which operation ceased are unknown. From conversations with older plant personnel and review of aerial photographs, a capacity of 50,000 gallons is estimated. It is believed that operations ceased in 1981. Previously Chemetco electrolytically refined its 99 percent pure anode copper to produce 99.9 percent pure copper cathodes. Sulfuric acid was the chief chemical used in the process. Spills, drips and rinses of sulfuric acid were flushed out of the tank house into the unlined slag/earthen basin. Minor amounts of hydrochloric and hydrobromic acids also were present in the floor washings.

2.3 Groundwater Users Within One (1) Mile

The Chemetco facility is located in a sparsely populated area. Consequently the number of withdrawal wells within one (1) mile of the site is low. There are no recorded public wells within a one-mile radius of the site. The only commercial/industrial wells are Chemetco's own wells. This well water is not used for human consumption.

Well logs for ten (10) private wells within one (1) mile of the Chemetco facility were obtained from State agencies. Figure 2-2 indicates their locations in relation to the site. Several of the wells indicated in the figure are believed to be no longer in use.

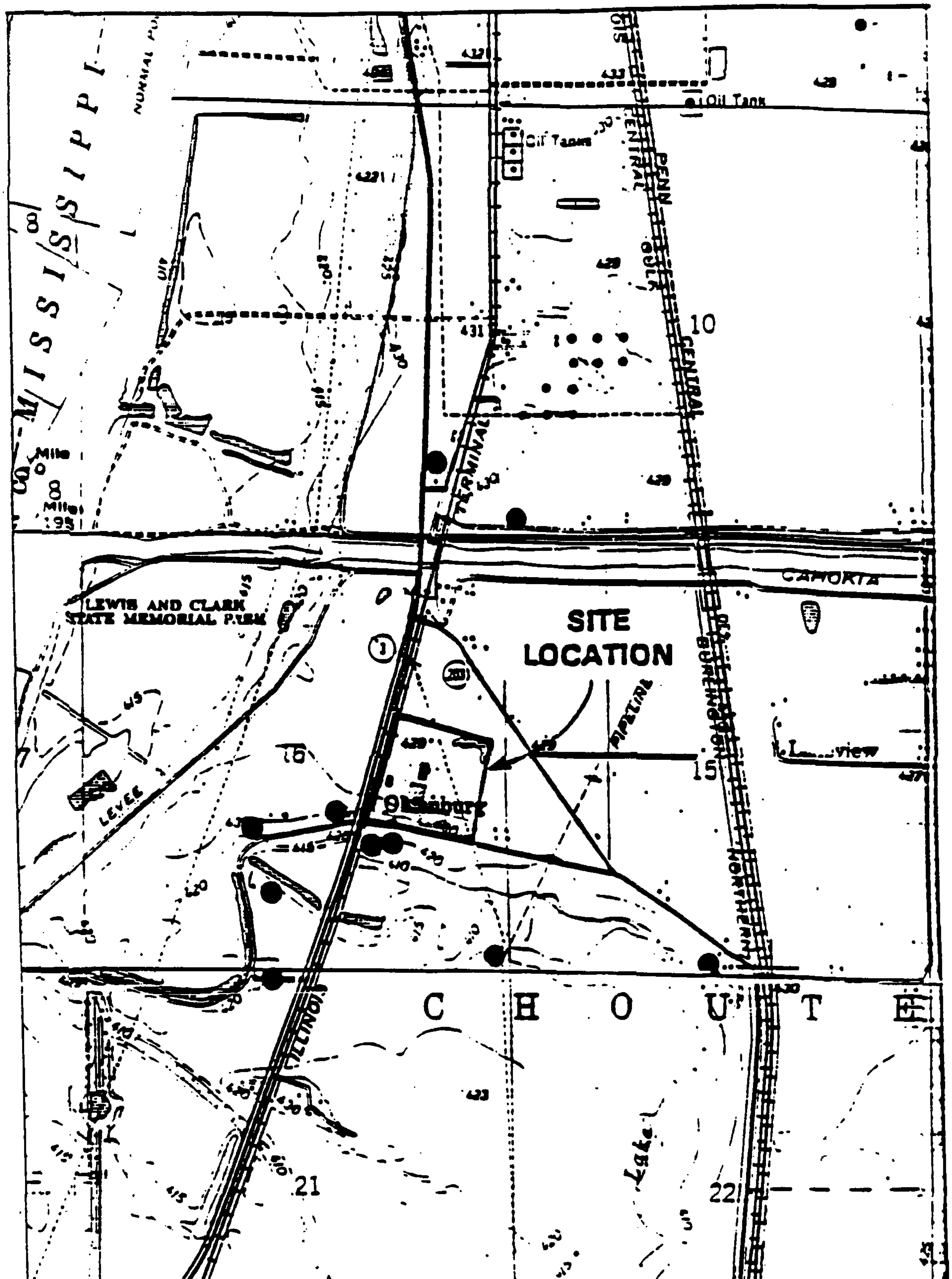


Source: U.S.G.S. 7.5 minute series topographic quad of Wood River, Illinois-Missouri

ENSR

FIGURE 2-1
SITE LOCATION MAP

DRAWN:	DATE: 3/1/93	PROJECT NO: 1100-004-400
CHK'D BY:	REVISED:	DWG. NO:



LEGEND

● PRIVATE WELL LOCAT

FIGURE 2-2
PRIVATE WELL LOCATIONS WITHIN ONE MILE OF THE FACILITY

APPENDIX 2-1

FORM 1 GENERAL

EPA

U.S. ENVIRONMENTAL PROTECTION AGENCY

GENERAL INFORMATION

Consolidated Permits Program

(Read the "General Instructions" before starting.)

I. EPA I.D. NUMBER

F ILD04884380

LABEL ITEMS

I. EPA I.D. NUMBER

III. FACILITY NAME

V. FACILITY MAILING ADDRESS

PLEASE PLACE LABEL IN THIS SPACE

VI. FACILITY LOCATION

GENERAL INSTRUCTIONS

If a preprinted label has been provided, affix it in the designated space. Review the information carefully; if any of it is incorrect, cross through it and enter the correct data in the appropriate fill-in area below. Also, if any of the preprinted data is absent (the area to the left of the label space lists the information that should appear), please provide it in the proper fill-in area(s) below. If the label is complete and correct, you need not complete Items I, III, V, and VI (except VI-B which must be completed regardless). Complete all items if no label has been provided. Refer to the instructions for detailed item descriptions and for the legal authorizations under which this data is collected.

II. POLLUTANT CHARACTERISTICS

INSTRUCTIONS: Complete A through J to determine whether you need to submit any permit application forms to the EPA. If you answer "yes" to any questions, you must submit this form and the supplemental form listed in the parenthesis following the question. Mark "X" in the box in the third column if the supplemental form is attached. If you answer "no" to each question, you need not submit any of these forms. You may answer "no" if your activity is excluded from permit requirements; see Section C of the instructions. See also, Section D of the instructions for definitions of bold-faced terms.

SPECIFIC QUESTIONS	YES	NO	FORM ATTACHED	SPECIFIC QUESTIONS	YES	NO	FORM ATTACHED
A. Is this facility a publicly owned treatment works which results in a discharge to waters of the U.S.? (FORM 2A)		X		B. Does or will this facility (either existing or proposed) include a concentrated animal feeding operation or aquatic animal production facility which results in a discharge to waters of the U.S.? (FORM 2B)		X	
C. Is this a facility which currently results in discharges to waters of the U.S. other than those described in A or B above? (FORM 2C)		X		D. Is this a proposed facility (other than those described in A or B above) which will result in a discharge to waters of the U.S.? (FORM 2D)		X	
E. Does or will this facility treat, store, or dispose of hazardous wastes? (FORM 3)	X			F. Do you or will you inject at this facility industrial or municipal effluent below the lowermost stratum containing, within one quarter mile of the well bore, underground sources of drinking water? (FORM 4)		X	
G. Do you or will you inject at this facility any produced water or other fluids which are brought to the surface in connection with conventional oil or natural gas production, inject fluids used for enhanced recovery of oil or natural gas, or inject fluids for storage of liquid hydrocarbons? (FORM 4)		X		H. Do you or will you inject at this facility fluids for special processes such as mining of sulfur by the Frasch process, solution mining of minerals, in situ combustion of fossil fuel, or recovery of geothermal energy? (FORM 4)		X	
I. Is this facility a proposed stationary source which is one of the 28 industrial categories listed in the instructions and which will potentially emit 100 tons per year of any air pollutant regulated under the Clean Air Act and may affect or be located in an attainment area? (FORM 5)				J. Is this facility a proposed stationary source which is NOT one of the 28 industrial categories listed in the instructions and which will potentially emit 250 tons per year of any air pollutant regulated under the Clean Air Act and may affect or be located in an attainment area? (FORM 5)			

III. NAME OF FACILITY

1 SKIP CHEMETCO INC.

IV. FACILITY CONTACT

A. NAME & TITLE (last, first, & title)	B. PHONE (area code & no.)
2 MICHELLE REZNACK ENVIRON. M.G.R.	618 254 4381

V. FACILITY MAILING ADDRESS

A. STREET OR P.O. BOX

3 P.O. BOX 187

B. CITY OR TOWN	C. STATE	D. ZIP CODE
4 ALTON	IL	62002

VI. FACILITY LOCATION

A. STREET, ROUTE NO. OR OTHER SPECIFIC IDENTIFIER

5 ROUTE 3 & OLDENBERG ROAD

B. COUNTY NAME

MADISON

C. CITY OR TOWN	D. STATE	E. ZIP CODE	F. COUNTY CODE (if known)
6 HARTFORD	IL	62408	

A. FIRST	B. SECOND
7 3341 (specify) SECONDARY COPPER SMELTER	7 (specify)
C. THIRD	**D. FOURTH**
(specify)	7 (specify)

VIII. OPERATOR INFORMATION

A. NAME

8 CHEMETCO, INC.

B. Is the name listed in Item VIII-A also the owner? ☐ YES

C. STATUS OF OPERATOR (Enter the appropriate letter into the answer box: if "Other", specify.)

F = FEDERAL
M = PUBLIC (other than federal or state)
S = STATE
O = OTHER (specify)
P = PRIVATE

P (specify)

D. PHONE (area code & no.)

A 618 254 438

E. STREET OR P.O. BOX

P.O. BOX 187

F. CITY OR TOWN	G. STATE	H. ZIP CODE
B ALTON	IL	62002

IX. INDIAN LAND

Is the facility located on Indian lands?

☐ YES ☐ NO

X. EXISTING ENVIRONMENTAL PERMITS

A. NPDES (Discharges to Surface Water)	D. PSD (Air Emissions from Proposed Sources)	
9 N L0025747	9 P	
B. UIC (Underground Injection of Fluids)	**E. OTHER (specify)**	
9 U	9 119801	(specify) AIR PERMIT (Construction)
C. RCRA (Hazardous Wastes)	**E. OTHER (specify)**	
	9	(specify)

XI. MAP

Attach to this application a topographic map of the area extending to at least one mile beyond property boundaries. The map must show the outline of the facility, the location of each of its existing and proposed intake and discharge structures, each of its hazardous waste treatment, storage, or disposal facilities, and each well where it injects fluids underground. Include all springs, rivers and other surface water bodies in the map area. See instructions for precise requirements.

XII. NATURE OF BUSINESS (provide a brief description)

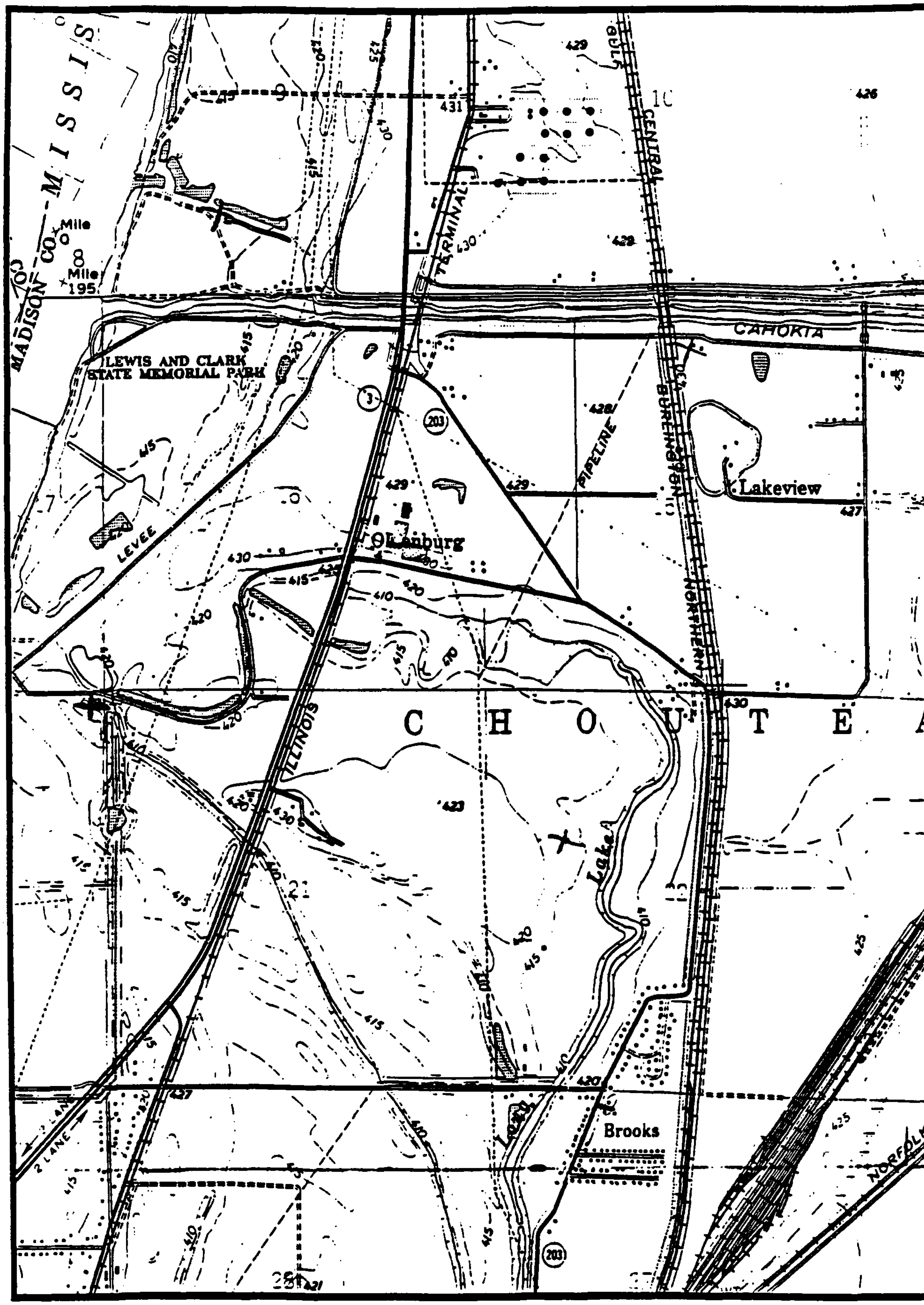
XIII. CERTIFICATION (see instructions)

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this application and all attachments and that, based on my inquiry of those persons immediately responsible for obtaining the information contained in the application, I believe that the information is true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

A. NAME & OFFICIAL TITLE (type or print)	B. SIGNATURE	C. DATE SIGNED
DAVID A HOFF PRESIDENT	[signature]	March 25, 1993

COMMENTS FOR OFFICIAL USE ONLY

C David Hoff, President March 25, 19



SCALE 1"=2083'

N

FORM 1, SECTION XI
TOPOGRAPHIC MAP

RCRA EPA HAZARDOUS WASTE PERMIT APPLICATION
Consolidated Permits Program
(This information is required under Section 3005 of RCRA.)

F I L D 0 4 8 8 4 3 8 0 9

FOR OFFICIAL USE ONLY

APPLICATION APPROVED	DATE RECEIVED (yr., mo., & day)	COMMENTS

II. FIRST OR REVISED APPLICATION

Place an "X" in the appropriate box in A or B below *(mark one box only)* to indicate whether this is the first application you are submitting for your facility or a revised application. If this is your first application and you already know your facility's EPA I.D. Number, or if this is a revised application, enter your facility's EPA I.D. Number in Item I above.

A. FIRST APPLICATION *(place an "X" below and provide the appropriate date)*

☐ 1. EXISTING FACILITY *(See instructions for definition of "existing" facility. Complete item below.)*

☐ 2. NEW FACILITY *(Complete item below.)*

C	YR.	MO.	DAY
8	69	06	01

FOR EXISTING FACILITIES, PROVIDE THE DATE *(yr., mo., & day)* OPERATION BEGAN OR THE DATE CONSTRUCTION COMMENCED *(use the boxes to the left)*

YR.	MO.	DAY

FOR NEW FACILITIES, PROVIDE THE DATE *(yr., mo., & day)* OPERATION BEGAN OR IS EXPECTED TO BEGIN

B. REVISED APPLICATION *(place an "X" below and complete Item I above)*

☐ 1. FACILITY HAS INTERIM STATUS

☐ 2. FACILITY HAS A RCRA PERMIT

III. PROCESSES – CODES AND DESIGN CAPACITIES

A. PROCESS CODE – Enter the code from the list of process codes below that best describes each process to be used at the facility. Ten lines are provided for entering codes. If more lines are needed, enter the code(s) in the space provided. If a process will be used that is not included in the list of codes below, then describe the process *(including its design capacity)* in the space provided on the form *(Item III-C)*.

B. PROCESS DESIGN CAPACITY – For each code entered in column A enter the capacity of the process.
1. AMOUNT – Enter the amount.
2. UNIT OF MEASURE – For each amount entered in column B(1), enter the code from the list of unit measure codes below that describes the unit of measure used. Only the units of measure that are listed below should be used.

PROCESS	PROCESS CODE	APPROPRIATE UNITS OF MEASURE FOR PROCESS DESIGN CAPACITY
Storage:		
CONTAINER *(barrel, drum, etc.)*	S01	GALLONS OR LITERS
TANK	S02	GALLONS OR LITERS
WASTE PILE	S03	CUBIC YARDS OR CUBIC METERS
SURFACE IMPOUNDMENT	S04	GALLONS OR LITERS
Disposal:		
INJECTION WELL	D79	GALLONS OR LITERS
LANDFILL	D80	ACRE-FEET *(the volume that would cover one acre to a depth of one foot)* OR HECTARE-METER
LAND APPLICATION	D81	ACRES OR HECTARES
OCEAN DISPOSAL	D82	GALLONS PER DAY OR LITERS PER DAY
SURFACE IMPOUNDMENT	D83	GALLONS OR LITERS
Treatment:		
TANK	T01	GALLONS PER DAY OR LITERS PER DAY
SURFACE IMPOUNDMENT	T02	GALLONS PER DAY OR LITERS PER DAY
INCINERATOR	T03	TONS PER HOUR OR METRIC TONS PER HOUR; GALLONS PER HOUR OR LITERS PER HOUR
OTHER *(Use for physical, chemical, thermal or biological treatment processes not occurring in tanks, surface impoundments or incinerators. Describe the processes in the space provided; Item III-C.)*	T04	GALLONS PER DAY OR LITERS PER DAY

UNIT OF MEASURE	UNIT OF MEASURE CODE
GALLONS	G
LITERS	L
CUBIC YARDS	Y
CUBIC METERS	C
GALLONS PER DAY	U
LITERS PER DAY	V
TONS PER HOUR	D
METRIC TONS PER HOUR	W
GALLONS PER HOUR	E
LITERS PER HOUR	H
ACRE-FEET	[illegible]
HECTARE-METER	[illegible]
ACRES	B
HECTARES	Q

EXAMPLE FOR COMPLETING ITEM III *(shown in line numbers X-1 and X-2 below)*: A facility has two storage tanks, one tank can hold 200 gallons and the other can hold 400 gallons. The facility also has an incinerator that can burn up to 20 gallons per hour.

C	DUP	T/A C	1

LINE NUMBER	A. PROCESS CODE (from list above)	B. PROCESS DESIGN CAPACITY 1. AMOUNT (specify)	2. UNIT OF MEASURE (enter code)	FOR OFFICIAL USE ONLY
X-1	S02	600	G	
X-2	T03	20	E	
1	S03	3,000,000	G	
2	D83	50,000	G	
3	D83	890,000	G	
4	D83	3,825,000	G	
5				
6				
7				
8				
9				
10				

III. PROCESSES *(continued)*

C. SPACE FOR ADDITIONAL PROCESS CODES OR FOR DESCRIBING OTHER PROCESSES *(code "T04")*. FOR EACH PROCESS ENTERED HERE INCLUDE DESIGN CAPACITY.

IV. DESCRIPTION OF HAZARDOUS WASTES

A. **EPA HAZARDOUS WASTE NUMBER** — Enter the four—digit number from 40 CFR, Subpart D for each listed hazardous waste you will handle. If yo handle hazardous wastes which are not listed in 40 CFR, Subpart D, enter the four—digit number*(s)* from 40 CFR, Subpart C that describes the character tics and/or the toxic contaminants of those hazardous wastes.

B. **ESTIMATED ANNUAL QUANTITY** — For each listed waste entered in column A estimate the quantity of that waste that will be handled on an annu basis. For each characteristic or toxic contaminant entered in column A estimate the total annual quantity of all the non—listed waste*(s)* that will be handle which possess that characteristic or contaminant.

C. **UNIT OF MEASURE** — For each quantity entered in column B enter the unit of measure code. Units of measure which must be used and the appropria codes are:

ENGLISH UNIT OF MEASURE	CODE	METRIC UNIT OF MEASURE	CODE
POUNDS	P	KILOGRAMS	K
TONS	T	METRIC TONS	M

acility records use any other unit of measure for quantity, the units of measure must be converted into one of the required units of measure taking int account the appropriate density or specific gravity of the waste.

D. **PROCESSES**

1. **PROCESS CODES:**
   For listed hazardous waste: For each listed hazardous waste entered in column A select the code*(s)* from the list of process codes contained in Item II to indicate how the waste will be stored, treated, and/or disposed of at the facility.
   For non—listed hazardous wastes: For each characteristic or toxic contaminant entered in column A, select the code*(s)* from the list of process code contained in Item III to indicate all the processes that will be used to store, treat, and/or dispose of all the non—listed hazardous wastes that posses that characteristic or toxic contaminant.
   Note: Four spaces are provided for entering process codes. If more are needed: (1) Enter the first three as described above; (2) Enter "000" in the extreme right box of Item IV-D(1); and (3) Enter in the space provided on page 4, the line number and the additional code*(s)*.

2. **PROCESS DESCRIPTION:** If a code is not listed for a process that will be used, describe the process in the space provided on the form.

NOTE: HAZARDOUS WASTES DESCRIBED BY MORE THAN ONE EPA HAZARDOUS WASTE NUMBER — Hazardous wastes that can be described by more than one EPA Hazardous Waste Number shall be described on the form as follows:

1. Select one of the EPA Hazardous Waste Numbers and enter it in column A. On the same line complete columns B, C, and D by estimating the total annual quantity of the waste and describing all the processes to be used to treat, store, and/or dispose of the waste.
2. In column A of the next line enter the other EPA Hazardous Waste Number that can be used to describe the waste. In column D(2) on that line enter "included with above" and make no other entries on that line.
3. Repeat step 2 for each other EPA Hazardous Waste Number that can be used to describe the hazardous waste.

EXAMPLE FOR COMPLETING ITEM IV *(shown in line numbers X-1, X-2, X-3, and X-4 below)* — A facility will treat and dispose of an estimated 900 pounds per year of chrome shavings from leather tanning and finishing operation. In addition, the facility will treat and dispose of three non—listed wastes. Two wastes are corrosive only and there will be an estimated 200 pounds per year of each waste. The other waste is corrosive and ignitable and there will be an estimated 100 pounds per year of that waste. Treatment will be in an incinerator and disposal will be in a landfill.

LINE NO.	A. EPA HAZARD. WASTE NO. *(enter code)*	B. ESTIMATED ANNUAL QUANTITY OF WASTE	C. UNIT OF MEASURE *(enter code)*	D. PROCESSES 1. PROCESS CODES *(enter)*	D. PROCESSES 2. PROCESS DESCRIPTION *(if a code is not entered in D(1))*
X-1	K 0 5 4	900	P	T 0 3 D 8 0	
X-	0 0 2	400	P	T 0 3 D 8 0	
	D 0 0 1	100	P	T 0 3 D 8 0	
X-4	D 0 0 2				included with above

NOTE: Photocopy this page before completing if you have more than 26 wastes to list. Form Approved OMB No. 158-S8000

EPA I.D. NUMBER (enter from page 1)	T/A	C	FOR OFFICIAL USE ONLY	T/A	C	
W I L D 0 4 8 8 4 3 8 0 9		1	W DUP		2	DUP

IV. DESCRIPTION OF HAZARDOUS WASTES (continued)

LINE NO.	A. EPA HAZARD. WASTE NO. (enter code)	B. ESTIMATED ANNUAL QUANTITY OF WASTE	C. UNIT OF MEASURE (enter code)	D. PROCESSES 1. PROCESS CODES (enter)				D. PROCESSES 2. PROCESS DESCRIPTION (if a code is not entered in D(1))
1	D006			S03	S04			
2	D008			S03	S04			
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								

EPA Form 3510-3 (6-80) CONTINUE ON REVERSE

IV. DESCRIPTION OF HAZARDOUS WASTES *(continued)*

E. USE THIS SPACE TO LIST ADDITIONAL PROCESS CODES FROM ITEM D(1) ON PAGE 3.

EPA I.D. NO. *(enter from page 1)*	
I L D 0 4 8 8 4 3 8 0 9	6

V. FACILITY DRAWING

All existing facilities must include in the space provided on page 5 a scale drawing of the facility *(see instructions for more detail).*

VI. PHOTOGRAPHS

All existing facilities must include photographs *(aerial or ground—level)* that clearly delineate all existing structures; existing storage, ...ment and disposal areas; and sites of future storage, treatment or disposal areas *(see instructions for more detail).*

...ACILITY GEOGRAPHIC LOCATION

LATITUDE *(degrees, minutes, & seconds)*	LONGITUDE *(degrees, minutes, & seconds)*
38 47 030	090 05 000

VIII. FACILITY OWNER

A. If the facility owner is also the facility operator as listed in Section VIII on Form 1, "General Information", place an "X" in the box to the left and skip to Section IX below.

B. If the facility owner is not the facility operator as listed in Section VIII on Form 1, complete the following items:

1. NAME OF FACILITY'S LEGAL OWNER	2. PHONE NO. *(area code & no.)*
CHEMETCO, INC.	618-254-4381

3. STREET OR P.O. BOX	4. CITY OR TOWN	5. ST.	6. ZIP CODE
P.O. BOX 187	G ALTON	IL	62002

IX. OWNER CERTIFICATION

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this and all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

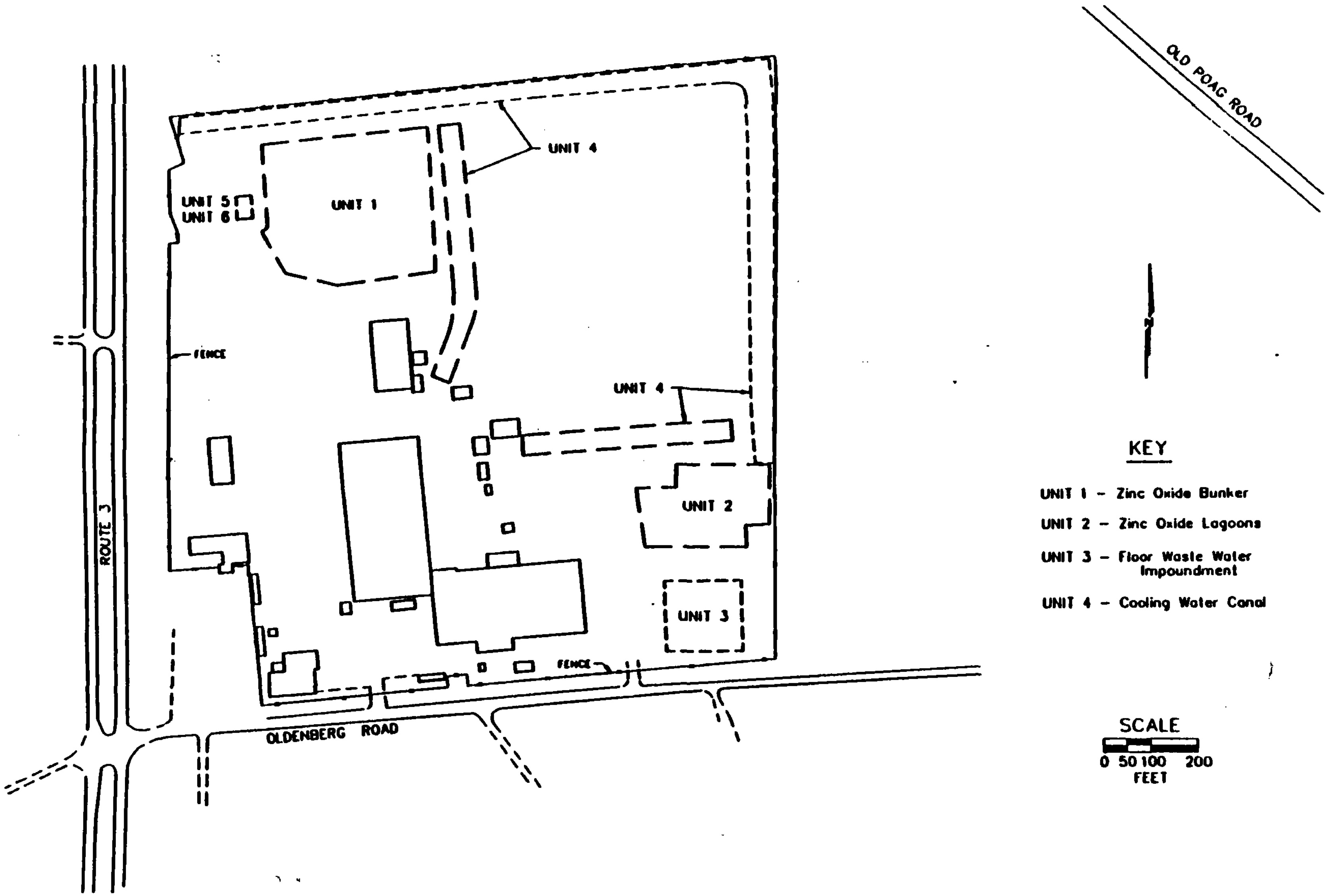
A. NAME *(print or type)*	B. SIGNATURE	C. DATE SIGNED
David A. Hoff	David A Hoff	March 25, 1993

X. OPERATOR CERTIFICATION

I ...fy under penalty of law that I have personally examined and am familiar with the information submitted in this and all attached ...ents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the ...ted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, ...ding the possibility of fine and imprisonment.

A. NAME *(print or type)*	B. SIGNATURE	C. DATE SIGNED
David A. Hoff	David A Hoff	March 25, 1993

FACILITY DRAWING (see page 4)



Form Approved OMB No 158-S80004

3.0 GROUNDWATER MONITORING

This document is presented as the revised groundwater monitoring plan for five (5) historical solid waste management units at Chemetco, Incorporated ("Chemetco"), Hartford, Illinois. The location of all five waste management units is provided in Figure 3-1. This groundwater monitoring plan in its original format was included as Section 3 of the Interim Status Revised Closure Plan & Post-Closure Plan dated June 1994. As committed to in a letter from Chemetco to the Illinois Environmental Protection Agency ("IEPA") dated March 10, 1997, the information contained herein has been amended to include the addition and deletion of monitoring wells, information previously submitted in the Hydrogeologic Evaluation dated November 1995 and the Response to Comments dated March 1997, and information from quarterly and annual reports submitted between 1994 and 1997. The quarterly and annual reports have been submitted to the Agency pursuant to the regulatory requirements of 35 Ill. Admin. Code, Part 725, Subpart F.

Chemetco submitted a RCRA Part B Post-Closure Permit Application dated March, 1993 detailing the groundwater monitoring requirements under Ill. Admin. Code 724. The Groundwater Monitoring Program contained within this document will meet the requirements of 35 Ill. Adm. Code, Part 724 Subpart F. When appropriate, Chemetco's Part B Permit Application will be revised to reflect the changes proposed to the Groundwater Monitoring Program in this Closure/Post Closure Plan Revision if they are approved by the IEPA.

Chemetco has conducted interim-status groundwater monitoring since January 1983. The hydrogeology of the site consists of an aquitard that contains lenses of water-bearing sand and silt underlain by the regional American Bottoms sand and gravel aquifer. The aquitard contains a perched sand aquifer that outcrops to the surface south of the facility. During 1983 monitoring, elevated metals concentrations were detected in the isolated, perched aquifer underlying the southeastern portion of the facility, with minor elevated metals concentrations in the lower, hydraulically disconnected regional aquifer. In May 1984, Chemetco voluntarily installed the subsurface interceptor drainage (SID) system to capture contaminated groundwater from the perched aquifer and prevent surface seepage in the perched aquifer outcrop area. Further field investigation focused on spatial delineation of the perched aquifer as recommended in the groundwater assessment plan report of June 1986. Additional groundwater quality analyses, hydrogeologic investigations and groundwater modeling initially led to a proposal for corrective action of contaminated groundwater in the upper zone of the regional aquifer. This information has been submitted to IEPA in a series of reports and letters between 1987 and present.

The SID system in the perched aquifer has been effective in preventing surface seepage as well as removal of contaminated water from the perched aquifer. In the Interim Status Revised Closure/Post Closure Plan dated June 1994, Chemetco proposed the designation of a groundwater management zone in the perched and regional aquifers while corrective action is taking place. All aquifers will be in compliance monitoring throughout the correction action program.

3.1 Exemption from Groundwater Protection Requirements: 703.185, 724.I(b)

Chemetco is not requesting exemption from groundwater monitoring requirements. Because the facility was not clean-closed it will require groundwater monitoring during a 30 year post-closure period.

3.2 Interim Status Groundwater Monitoring Data: 703.185(a)

Chemetco conducted monthly groundwater sampling from January 1983 to March 1986 and additional sampling from May to June 1987, January 1988, April 1989, August 1989, June 1992, September 1992, and December 1992. Quarterly sampling (January, April, July, October) has been conducted since 1993. Groundwater elevations have been recorded at various intervals throughout the field investigations. Groundwater elevation data can be found in Appendix 3-1. Water quality and flow rate data have been collected periodically from the SID system as well (Appendix 3-2).

Chemetco received approval of final closure and post closure groundwater monitoring plans from IEPA on April 19, 1991 subject to a number of conditions. Conditions in the letter were addressed by Chemetco and resubmitted. Final approval of closure and post-closure plans with modifications was approved by the IEPA in a letter to David Hoff (Chemetco) dated January 29, 1993 (hereafter referred to as the January 29, 1993 approval letter). Copies of these letters are included in Appendix 3-3. Chemetco has collected groundwater elevation data and has conducted groundwater sampling on a quarterly basis since the 2nd quarter of 1992. Three quarterly reports and the annual report were submitted for 1992. Four quarterly reports and an annual report have been submitted between 1993 and 1997. To date, three quarterly reports have been submitted in 1998. Summaries of all groundwater monitoring data collected during the interim status period through 1996 is provided in Tables 3-1 and 3-2 and Appendix 3-4. Summaries of groundwater monitoring data collected for the first three quarters of 1997 is also included in Appendix 3-4.

3.2.1 Description of Wells: 725.191(a) and (c)

As discussed in detail in Section 3.3, the aquitard is composed of clay and silt with sand lenses found in the southeastern portion of the facility. Originally, twenty-two monitoring wells were screened in the aquitard, four in the clay and silt (10, 11A, 20 and 30) and eighteen in the sand lenses (2B, 4A, 5A, 7A, 8A, 9, 12, 14, 15, 16, 17, 19, 21, 25, 27, 28, 31A and 41). Twenty monitoring wells were screened in the upper zone of the regional aquifer (1A, 3A, 7, 11, 13, 22, 26, 29, 31, 32 ,33, 34, 35, 37R, 38, 40R, 42, 44, 45 and 47), and four monitoring wells were screened in the lower zone of the regional aquifer (36, 39, 43, 46).

The plant has two water supply wells, the East well and West well, screened in the lower zone of the regional aquifer. One gradient control pumping well, Pumping Well B, screened in the upper zone of the regional aquifer was installed near the northwestern corner of the facility in 1989. A second pumping well, Pumping Well D, screened in the upper zone of the regional aquifer was installed in December of 1992.

To date, pumps have not been installed in these wells since it appears that the SID system is effective in the perched aquifer and Chemetco's water supply wells are maintaining an inward gradient in the upper regional aquifer.

A number of wells were formerly abandoned following Illinois Department of Public Health (IDPH) protocols because of damage or improper construction. These include wells 2, 4, 5, 8, 18, 23, 24, 32 and 37. Well 32 was replaced with Well 32R located within 10 feet of Well 32. Well 37 was replaced with well 37R, located approximately 2 feet to the south. Well 40 was abandoned during the Spring of 1993. A replacement well, 40R was installed in the vicinity of Well 40. An additional set of wells (31, 31A, 33, 35, 36, 38 and 39) were repaired.

Most recently (April 15, 1997, and May 7, 1997), twenty-nine wells were abandoned and fifteen new or replacement groundwater monitoring wells were installed. Wells abandoned include 2B, 1A, 3A, 4A, 5A, 7, 7A, 8A, 11, 11A, 45, 19, 20, 21, 22, 30, 34, 35, 36, 38, 39, 40, 42, 44, and 47. Verbal permission was requested by CSD and granted by Ms. Terri Myers of the Agency to abandon wells 9, 10, 13, and 14. IDPH Well Abandonment Forms are included in Appendix 3-5. Locations of those wells abandoned and those newly installed wells are included in Figures 3-2 and 3-3, respectively. Of the 29 wells abandoned, monitoring well 21 could not be located in the field and was therefore not abandoned. Also, monitoring wells 11 and 11A could not be abandoned and replaced by 11AR in its original position. The area was to wet to allow access to the drill rig. The replacement well for 11 and 11A was installed approximately 60 feet west of its original location. This was discussed with IEPA prior to the installation of the new well. The new well is located adjacent to the temporary decontamination pad which was constructed for remediation of the zinc oxide spill area. This well was numbered 56 since it was located greater than 10 feet from its original position. In August of 1997, Chemetco was able to abandon monitoring wells 11 and 11A.

Locations of all site wells which are currently part of the groundwater monitoring system are shown on Figure 3-1. Monitoring well construction diagrams and boring logs are included in Appendix 3-6. Table 3-3 shows original and revised monitoring well nomenclature along with well specifications.

3.2.2 Description of Sampling/Analysis Procedures: 725.192(a)

Sampling and analysis procedures are described in Appendix 3-7.

3.2.3 Monitoring Data: 725.192(b), (c), (d), and (e)

This section documents analytical results from the various water quality sampling events that have occurred at the Chemetco facility since the initiation of site investigations in 1983. Results of groundwater sampling are discussed in more detail in Section 3.5.1 and 3.5.2. Groundwater samples were analyzed for different constituents in each sampling round for the 1983 to 1989 analyses. These variations in constituents were the result of the differing goals of the individual sampling programs and variations in the regulatory environment regarding these sampling programs. Summaries of metal (copper, zinc, lead, cadmium, chromium, arsenic, and nickel) analyses, pH, total dissolved solids (TDS), boron, and chloride are presented in Table 3-1 (perched aquifer/aquitard) and Table 3-2 (regional aquifer). These results were chosen for tabulation because inorganic constituents are the constituents of concern at this facility. Results of other data periodically collected are included as raw laboratory data in Appendix 3-4 of the Interim Status Revised Closure and Post-Closure Plan, June 1994.

From January 1983 to January 1986, monitoring wells 1A through 21 were generally analyzed on a monthly basis for the following parameters: pH, copper, zinc, nickel, boron, TDS and chloride. The parameters analyzed were chosen because they were detected at concentrations which were above or, in the case of pH, below background levels as determined by the water quality analyses of well 11, an upgradient well screened in the regional aquifer. In May 1987, a subset of these monitoring wells (1A, 2B, 3A, 8, 8A, 11, 11A, 19, 20 and 21) was analyzed for these parameters plus additional parameters that included the eight RCRA metals, fluoride, iron, manganese, sodium, nitrate, pesticides, phenols, radium, alpha radioactivity, beta radioactivity, sulfates, total coliform, total organic carbon (TOC), and total organic halogens (TOX).

In June 1987 wells 1A, 2B, 3A, 8, 8A, 11, 11A, 19, 20 and 21 were sampled for drinking water parameters, including metals, inorganic parameters, pesticides, and bacteriological and radiological parameters. Except for the compounds discussed in the water quality sections (metals and related water quality indicators), no compounds or parameters were detected outside the expected range for drinking waters.

In 1988, monitoring wells 22 through 29 were installed at the site, and the following wells were analyzed for arsenic, cadmium, copper, nickel, lead, zinc, pH and chloride: 2B, 12, 15 and 17. When monitoring wells 30 through 33 were installed in March and April 1989, the following wells were sampled: 3A, 5, 5A, 7, 7A, 8, 8A, 11, 11A, 12, 14, 16, 17, 20, 22, 23, 24, 25, 26, 27, 28, 31, 31A, 32 and 33. The samples were analyzed for various suites of parameters that included aluminum, arsenic, cadmium, calcium, chloride, chromium, copper, fluoride, iron, lead, magnesium, manganese, potassium, sodium, tin, zinc, TOC, TOX, TDS, phenols, alkalinity, carbonate, bicarbonate, nitrate, sulfate, silica dioxide, phosphate, pH, specific conductance, redox potential and dissolved oxygen. Selected samples (from wells 22 and 31A) were also analyzed for volatile organic compounds (VOC), semi-volatile organic compounds (SVOC), herbicides and pesticides.

Wells 22, 31A, the zinc oxide impoundment, and the floor wash water impoundment were sampled for 40 CFR 261 Appendix VIII and 40 CFR 264 Appendix IX constituents in May and August 1989 .

Chemetco's water supply wells, screened in the lower zone of the regional aquifer, were sampled for drinking water parameters in June 1990, 1996, and 1997. Monitoring wells screened in the lower zone of the regional aquifer were not sampled until June 1992.

Since June 1992, samples taken during quarterly groundwater monitoring have been analyzed for: arsenic, cadmium, chromium, copper, lead, tin, zinc, pH, specific conductance, total organic carbon (TOC), and total organic halogens (TOX). Nickel was added in 1993.

In December 1992, October 1993, October 1994, October 1995, and October 1996 wells 28, 31A (perched aquifer), 34, 44 and 47 (upper zone of the regional aquifer) were sampled for Appendix I metals and semi-volatiles. All semi-volatile constituents were below detection limits in all samples.

Water withdrawn from the SID system has generally been sampled for antimony, zinc, iron, lead, copper, nickel, arsenic, and pH several times a month from April 1984 to December 1987 and in September 1990, November 1990, September 1991, and October 1992. Since October of 1992, the SID system is sampled and analyzed quarterly for arsenic, cadmium, chromium, copper, iron, nickel, lead, tin, zinc, and pH.

3.2.4 Statistical Procedures: 725.193(b), (c), and (d)

The initiation of field investigations resulted in detection of elevated metals concentrations in groundwater beneath the Chemetco facility. No statistical methods were used or needed to demonstrate that contamination was present in the perched aquifer.

3.2.5 Groundwater Assessment Plan: 725.193(d)

A groundwater assessment plan was developed under 35 Ill. Adm. Code 725.193(d) by Environmental Science and Engineering, Inc. in June 1986. Twenty six wells were monitored for water chemistry data; the determination was made that contamination was confined to the perched sand aquifer. All wells not screened in the perched unit had median copper concentrations below l mg/L.

The groundwater assessment plan recommended further delineation of the shallow sand lenses using a resistivity survey and a boring survey. The geophysical survey was conducted over the sand lense in July 1986; eight monitoring wells were installed in the southeast corner of the facility in October 1988. This work defined the extent of the shallow sand lense.

Five wells were installed in the upper zone of the regional aquifer by ENSR in March 1989 to further reevaluate the chemistry in that zone and to replace potentially improperly sealed wells.

3.3 General Hydrogeologic Information: 725.194

The Chemetco facility is underlain by a clay and silty clay unit ranging from approximately 20 to 60 feet in thickness. Interbedded within the clay in the southeastern quadrant of the facility is a sand lense (also referred to as the perched sand aquifer). The perched sand aquifer extends from 5 to 20 feet below grade with a maximum thickness of 15 feet and is bounded above and below by the clay and silty clay. The hydraulic conductivity of the perched unit has been calculated from slug test data to be 2.8×10^{-3} cm/sec. The results of recent investigations indicate that the water flows from north to south across the southeastern quadrant of the facility. Data indicate the water-bearing formation does not extend to the facility northern and western boundaries and stops within 300 feet of the southern and eastern boundaries. A second sand and silt lense has been identified, based on water level elevations, to the east of well 12.

The clay layer averages 10 feet in thickness beneath the shallow perched zone and increases to 25 feet in thickness in the northern portions of the Chemetco facility (where the perched sand aquifer is not present). The hydraulic conductivity of the clay layer based on slug test data indicate a hydraulic conductivity of 4.6×10^{-5} cm/sec which is two or more orders of magnitude lower than the aquifers and therefore constitutes an aquitard.

Beneath the clay is a layer of fine to silty sand that grades to coarse sand with depth and finally to sand and gravel. This unit is the regional American Bottoms Aquifer. The regional aquifer is generally greater than 90 feet thick and extends to the bedrock. Although there is not distinct boundaries between the formations in the regional aquifer, the regional aquifer is considered here to be comprised of two distinct hydrogeologic units given the gradation from silty sand to coarse sand and gravel. The hydraulic conductivity of the upper regional zone determined by slug tests and pumping tests is 1×10^{-2} cm/sec. The hydraulic conductivity of the lower zone of the regional aquifer determined by pumping tests is 1×10^{-1} cm/sec. Regional groundwater flows to the north and west in the area; water level data from monitoring wells at the site suggest groundwater flows west-northwest across the site. The regional aquifer is reportedly a drinking water source downgradient of Chemetco; Hartford municipal wells are reportedly northwest of the facility. In addition, potable water for the Chemetco facility is drawn from the two facility water supply wells, screened in the lower regional aquifer. The regional aquifer ultimately discharges to the Mississippi River.

3.3.1 Regional Hydrogeology

The Chemetco site is located in the flood plain of the Mississippi River in an area locally referred to as the American Bottoms. This area is characterized by relatively flat topography. The gradient of the Mississippi River in the American Bottoms is about 6 inches per mile or 9.5×10^{-5}. The land surface gradient over a similar area is about 12 inches per mile or 6.3×10^{-5} both of these gradients are extremely flat.

Precipitation to the American Bottoms falls on the flat surface and either infiltrates into the ground or evaporates. Because of the flat surface there is very little runoff. Recharge to the groundwater system in this area is received from the highlands surrounding the American Bottoms, infiltration from channels, and Mississippi River flood waters. Infiltration of water into the ground is restricted by the clay and silt layer found near the surface. The source of some recharge may be the bedrock aquifer near pumping centers.

Under non-pumping conditions the regional groundwater flow in the American Bottoms aquifer is expected to be toward the west or southwest towards the Mississippi River.

The clean sand and gravel deposits in the bottom zone of the American Bottoms aquifer constitute the major water-producing zone in the area. These deposits are utilized as groundwater supplies for municipal and industrial withdrawals, including Chemetco, Figure 3-4 shows the groundwater divides created by the major pumping centers in the area of the Chemetco site (Kohlhase, 1987). In 1951 these pumping centers produced a maximum withdrawal of 110 million gallons per day (mgd). In 1985 the withdrawal rate had declined to about 60 mgd (Kohlhase, 1987).

The Illinois State Water Survey (Water Survey) conducts periodic water-level monitoring programs of selected wells in the American Bottoms aquifer. Utilizing this water-level data the Water Survey produces a potentiometric map of the aquifer. This potentiometric map shows that aquifer withdrawals have significantly changed the groundwater flow direction within the aquifer and the flow is directed towards the various pumping centers. Using the potentiometric map, the Water Survey has determined the approximate locations of groundwater divides between the pumping centers. These divides, whose exact locations change according to variations in recharge and withdrawal rates, delineate the approximate areas of influence of the pumping centers.

Figure 3-4 shows that the Chemetco site is on the edge of the area of influence of the Poag pumping center. The Chemetco site is also located just south of the areas of influence of the Roxana and Wood River pumping centers. The regional mapping does not have sufficient delineation of the groundwater contours in the Chemetco site area to determine the regional direction of groundwater flow. The flow in this area, however, should be towards the Mississippi River.

Because of the prolific production of the American Bottoms aquifer, the limestone aquifer below the American Bottoms aquifer has not been tapped for groundwater supplies. It is believed, that the limestone aquifer could also be a source for high capacity production wells; water sampling in other areas has shown that this bedrock aquifer is highly mineralized.

3.3.2 Local Hydrogeology

The interpretation of the local hydrogeology is based on approximately 56 borings, 69 monitor wells, three pumping tests, 33 slug tests, 3 physical laboratory tests and numerous rounds of water-level measurements.

Perched Aquifer/Aquitard

As stated previously, the stratigraphy of the site is divided into two distinct units: (l) the aquitard, a unit composed of clay and silt with occasional interbedded lenses of sand and silt, referred to as the perched sand aquifer, and (2) the regional aquifer, a unit composed of sand and gravel. Figure 3-5 shows the areal distribution of the interbedded lenses of sand and silt in the aquitard as determined by on-site borings and water-level measurements. This figure shows that the portion of the aquitard containing interbedded lenses of sand and silt is limited to the southeastern portion of the property. A cross-section of site geology is shown in Figure 3-6.

Additional cross-sections can be found in plates 2 and 3 of the January 1991 report entitled "Hydrogeologic Summary, Chemetco Inc. Facility, Hartford, IL" prepared by ENSR.

Figure 3-6 also shows the potentiometric surfaces in both the perched sand lense of the aquitard and the regional aquifer in cross-sectional view. The data on this figure were selected to reflect the full range in water-level elevations observed at the site. The water level in the perched aquifer is at a significantly higher elevation that the water level in the regional aquifer. The relative positions of the potentiometric surfaces and water bearing zones demonstrate that the lenses of sand and silt in the aquifer are perched above the regional aquifer. This relationship effectively separates these two zones into different hydrogeologic units.

Figure 3-7 is a water-table map for the perched zone of the aquitard on September 9, 1992. The map was prepared using water-level measurements of wells screened in the perched aquifer and water-levels in the vicinity of the SID system known from the placement of SID system drainage pipes. Water-level measurements have been made on several other dates and all measurements have shown similar water-table configurations. Figure 3-7 shows that the direction of groundwater flow is to the south. Figure 3-8 is a water-table map from the July 1997 sampling event. The new monitoring system confirms groundwater flow direction in the perched aquifer. Potentiometric maps for 1993 through 1997 are included in Appendix 3-8.

Water level measurements of the wells screened in the aquitard have also shown that the sands screened in monitor wells located east of well 12, wells 41 and 19, have water levels at elevations between the perched zone and the regional aquifer. This difference in water level elevations and the nonexistence of sand lenses between these two areas as shown by wells 13 and 18, indicate that the sand lenses to the east of Well 12 are isolated from the sand lenses located in the southeastern corner of the facility where groundwater contamination has been found.

During the course of the site investigations, slug tests have been conducted on five wells screened in the perched sand lense of the aquitard. The hydraulic conductivities ranged from 8.5×10^{-4} to 2.2×10^{-2} centimeters per second (cm/sec), with a geometric mean of 2.8×10^{-3} cm/sec.

Using the geometric mean hydraulic conductivity determined from slug tests performed on wells screened in the sand lense (2.8×10^{-3} cm/sec), the hydraulic gradient of 0.022 calculated from detailed water-level measurements taken on October 17, 1990, and an assumed effective porosity of 0.25, a groundwater flow velocity of 2.5×10^{-4} cm/sec or 0.70 feet per day (ft/day) has been calculated. The groundwater flow velocity has been calculated using Darcy's Law (Freeze and Cherry, 1979) as follows:

$$V = K * I/n \qquad (3\text{-}I)$$

where:

V = velocity of groundwater flow (cm/sec);

K = hydraulic conductivity (cm/sec);

I = hydraulic gradient; and,

n = effective porosity.

Using this same data and the width, 600 feet, and thickness, 9 feet, of the sand lense in the aquitard, a groundwater flow rate of 950 cubic feet per day or approximately 7,000 gallons per day (gpd) has been calculated. This rate was calculated using Darcy's Law as follows:

$$Q = K * I * A \tag{3-2}$$

where

Q = quantity of groundwater flow (ft^3/day);

K = hydraulic conductivity (ft/day);

I = hydraulic gradient; and

A = area of flow (width * depth) (ft^2).

The groundwater flow rate through the aquifer of 7,000 gpd is in the general range of the rate of groundwater recovered from the SID system (normal range of withdrawal rates 4,000 to 12,000 gpd). The SID system spans the full width and depth of the aquifer so this correlation between rates was expected.

Slug tests were also conducted on three wells screened in the silt and clay layer but not in a sand lense. These slug tests yielded an average hydraulic conductivity of 4.6×10^{-5} cm/sec. To verify this hydraulic conductivity a laboratory test of hydraulic conductivity was performed on three silty clay samples from wells 31, 32 and 33. These samples were analyzed by GZA by the "falling head permeability test with back pressure" method. They hydraulic conductivities determined by this method were 3.0×10^{-8}, 1.5×10^{-7} and 8.0×10^{-9} cm/sec.

American Bottoms or Regional Aquifer

The American Bottoms or regional aquifer has been divided into two zones at the site. The upper zone is a fine sand with some gravel and silt, and the lower zone is a coarse sand and gravel. Although the aquifer consists of two zones, these zones have similar water-level elevations, showing that the units are in relative equilibrium. Water levels were collected from wells 1A-36, 22-46, 7-43 and 38-39 on May 14, 1990 and October 14, 1990. These water-level elevations show that, except for the May 14, 1990 measurement for the well pair 7 - 43, the differences between the water-level elevations in the upper and lower zones of the regional aquifer are 0.05 feet or less. This difference is considered insignificant.

The difference in water-level elevation in the lower and upper zones of the regional aquifer measured 0.17 feet on May 14, 1990 for well pair 7 - 43. Other water-level elevations for this well pair during the days surrounding these water-level measurements showed much smaller differences in water-level elevation. These water-level observations further confirm that the upper and lower zones of the regional aquifer are separate units but that the water levels within these units rapidly reach equilibrium.

The water-level elevation in the regional aquifer is typically 20 feet below the water-level elevation in the perched sand lenses, indicating a downward gradient. The water levels in the regional aquifer are normally located at an elevation near the contact of the overlying clay layer with the regional aquifer (Figure 3-6). The water levels in the regional aquifer fluctuate due to variations in the pumping of the Chemetco wells and due to variations in precipitation, and therefore, recharge to the regional aquifer. Under these varying conditions the water level elevations in the wells screened in the regional aquifer will fluctuate above and below the top of aquifer, changing from semi-confined conditions to water-table conditions.

A hydrogeologic evaluation was conducted on the upper and lower regional aquifers in June of 1995 to determine the groundwater flow direction beneath the plant. Pressure transducers were temporarily installed in wells 31, 33, 36, 37R, 42, 43, 44, 46, and 47 for five days from May 31, to June 4 to monitor water levels. The Well Sentinels were set to the top of casing mode. In this mode the Well Sentinels measure the height of water above the pressure transducer which hangs in the well, and subtracts that from the distance from the pressure transducer to the top of casing (this distance is inputted by the user as the cable length) the resulting reading is a measure of the distance from the top of the casing to the top of the water in the well. The transducers were programmed to collect a groundwater reading every fifteen minutes during the five-day test. In addition, the production wells were shut down for a period of approximately 24 hours during the test to determine the effect of the wells on the aquifer. The results of the hydrogeologic evaluation indicated a cone of depression exists in the upper regional aquifer from the on site production wells. An average drawdown of 3.8 feet was calculated.

Figure 3-9 is a potentiometric map of the upper zone of the regional aquifer on September 9, 1992. Figure 3-9 shows the flow direction in this unit is to the west-northwest. Flow direction in 1992 was predominately from the north to the south. The water level elevations shown on this figure may be affected by plant supply well pumping. Groundwater flow direction for April, July and October 1993 was from the west to the southeast. Water level elevations during 1994, 1995, and 1996 also appear to be influenced by on-site production wells (Appendix 3-8), hence the inward gradient as illustrated in Figure 3-10. This flow direction is different from the southerly flow direction in the perched aquifer.

The hydraulic conductivity of the sediments in the regional aquifer has been determined by both slug tests and pumping tests. Eleven wells in the upper unit of the regional aquifer were evaluated using slug tests. The hydraulic conductivity determined from these slug tests ranged from 3.6×10^{-5} to 1.4×10^{-2} cm/sec with an average of 8.0×10^{-4} cm/sec.

On May 18, 1990 the "pump well" also referred to as "Pumping Well B" screened in the upper zone of the regional aquifer, was pump tested. This pumping test was designed to determine the hydraulic conductivity of the upper zone of the regional aquifer by pumping a well which was screened in the upper zone of the regional aquifer. Rainfall prior to the test prohibited analysis of the observation well data.

Even though the monitor well data was not analyzed, the water-level data collected from the pumping well was used to obtain an estimate of the hydraulic conductivity of the upper zone of the regional aquifer. An aquifer transmissivity of 2,700 ft^2/day was estimated using the specific capacity of the pumping well (Driscoll, 1986). Dividing this aquifer transmissivity by the aquifer thickness of the upper zone of the regional aquifer, 65 feet, a hydraulic conductivity of approximately 40 feet per day or 1.4×10^{-2} cm/sec was calculated. Assuming that the well was at least 50 percent efficient, an aquifer transmissivity of 5,400 ft^2/day, a hydraulic conductivity of approximately 80 feet per day or 2.8×10^{-2} cm/sec was calculated. Based on these hydraulic conductivities and hydraulic conductivity determined from slug testing (1.4×10^{-2} cm/sec), a hydraulic conductivity of 1×10^{-2} cm/sec appears to be reasonable for the upper zone of the regional aquifer.

On August 1, 1989, a pumping test was performed on Chemetco's east water supply well, screened in the lower zone of the regional aquifer. Analyses were performed on water-level data from 15 wells screened in the upper zone of the regional aquifer. The results of the pumping test analyses show an average aquifer transmissivity of 20,000 ft^2/day (square feet per day). Assuming an aquifer thickness of 110 feet, including both the upper and lower zones of the regional aquifer, the hydraulic conductivity of the regional aquifer was calculated to be 180 ft/day (feet per day) or 6.4×10^{-2} cm/sec. This hydraulic conductivity is significantly higher than the average hydraulic conductivity, 8.0×10^{-4} cm/sec, determined from the slug tests of the upper zone of the regional aquifer.

A pumping test was conducted on the Chemetco west supply well on May 19, 1990. This pumping test was conducted because four wells (36, 39, 43 and 46) screened in the same lower zone of the regional aquifer as the west well had been installed since the pumping test of the east well in August 1989. The drawdown in the pumping well was analyzed to determine an aquifer transmissivity of 21,000 ft^2/day (Driscoll, 1986). This transmissivity is similar to the average transmissivity determined for the monitoring wells from the pumping test of the east well. Dividing this transmissivity by the thickness of the lower zone of the regional aquifer, 55 feet, yields a hydraulic conductivity of 380 ft/day or 1.2×10^{-1} cm/sec. This hydraulic conductivity appears reasonable for the sands and gravels identified in the lower zone of the regional aquifer. The expected hydraulic conductivity for these sediments is in the 1×10^{-1} to 1 cm/sec range.

Contaminant Velocity

To estimate the velocity of aqueous metals, sorption to aquifer material must be considered; it is not sufficient to equate contaminant velocity with water velocity. Cations (positively charged ions, typically metals) are attracted to the predominately negatively charged surfaces on matrix particles (especially clays). The attraction between cation and particle surfaces results in an attenuation (retardation) of cation velocity relative to water velocity because of cation residence-time on aquifer matrix surfaces. The retardation factor (R) is generally expressed as:

$$R = V_w/V_s \qquad (3\text{-}3)$$

where V_w = water velocity, and
V_s = solute velocity.

Retardation due to cation adsorption is a function of aquifer bulk density (P_{BD}) porosity (n), and partition coefficient (K_d), and the equation defining this retardation is usually written as (Domenico & Schwartz, 1990):

$$R = l + (P_{BD} * K_d)/n \qquad (3\text{-}4)$$

The use of this equation requires the assumption of solution/surface equilibrium and a linear sorption (Freundlich) isotherm. A linear isotherm is a good assumption for low solute concentrations, and we have no reason to suspect gross disequilibrium.

For example, to obtain a rough calculation of R for copper in the vicinity of the former well, 11A, assume a particle density of 2.5 g/cm^3, and porosity of 0.3. This yields a bulk density of l.8 g/cm^3. An average partition coefficient for copper in agricultural soils and clays as in Baes & Sharp (1983), (mean K_d = 22 mL/g) minus one standard deviation (O = 3mL/g) yields a conservative estimate for copper partitioning of 19 mL/g. From equation (3-4) above, a value of R = 120 is calculated.

The third quarter 1992 groundwater report includes groundwater elevations for wells 29 and 11A (since abandoned) of 409.02 and 405.43 feet respectively. Well 11A is screened in the silt/clay of the aquitard, while well 29 is screened at a similar depth in a relatively thin (5 ft) sand unit overlain by, underlain by, and probably pinching out into aquitard material. Since these wells are 460 feet apart, a horizontal gradient of (409.02 - 405.43) feet/460 feet = 0.0078 exists. Slug test data indicate a hydraulic conductivity of 4.6×10^{-5} cm/sec for the silt/clay aquitard. From equation (2-l), the groundwater velocity between wells 29 and 11A is 1.2×10^{-6} cm/sec or 1.2 ft/yr toward well 11A.

Using equation (3-3), the above groundwater velocity and retardation of approximately 120, an order of magnitude approximation of copper velocity of 0.01 ft/yr is calculated for the aquitard south of the facility.

The contaminant velocity in the upper zone of the regional aquifer will be much faster than in the aquitard because of faster groundwater velocity and a lower affinity of cations for matrix surfaces. The contaminant velocity will be toward the direction of pumping wells on site as specified in the groundwater gradient control well system.

3.4 Topographic Map Requirements: 703.183(s), 703.185(c)

Chemetco had a topographic map of the facility and surrounding area made in 1987. However, because Chemetco owns in excess of 270 acres, the property boundary cannot be plotted on this topographic map as requested.

A base map showing the facility fence line and all monitoring wells is included as Figure 3-1. The points of compliance for the perched and regional aquifers are included as Figures 3-11, 3-12, and 3-13. The facility is located on 40 fenced acres of Chemetco property and contains the waste management areas and points of compliance.

3.5 Contaminant Plume Description: 703.185(d), 721-Appendix I

This section describes the results of the analytical sampling performed at the facility. Since the groundwater monitor well network has recently been updated, Chemetco will include isoconcentration maps based on representative data in the semi-annual reports due July 1 and January 1 of every year to illustrate the extent of contamination starting on July 1, 1998. Sufficient data from the new wells should be collected by the date of the annual report to allow the construction of preliminary isoconcentration maps. As indicated in Section 3.2.3, only inorganic constituents have been detected in groundwater at elevated concentrations. This is consistent with the smelting operations performed on the property. The facility utilizes only minimal quantities of organic compounds for maintenance. Sampling for organic constituents has detected no constituents above cleanup objectives.

3.5.1 Groundwater Quality of the Perched Aquifer/Aquitard

Table 3-1 presents results of the pH, TDS, chloride, boron and metals (copper, zinc, cadmium, chromium, arsenic, lead and nickel) analyses of wells screened in the perched aquifer/aquitard through 1996. Additional data tables for 1997, as well as 1993 through 1996 are included in Appendix 3-4. The table has been divided into wells screened in the clay and silt (aquitard) and wells screened in the sand lenses and concentrations are averages for the year unless noted in the table.

Within the shallow aquifer, the contaminants consist of the metals copper, arsenic, cadmium, lead, chromium, nickel, and zinc with associated low pH. The majority of contamination in the shallow aquifer occurs hydraulically down-gradient of the former floor wash impoundment and consists mainly of cadmium and chromium. Well 31A lies immediately down-gradient of the floor wash impoundment and its water contains the highest concentration of cadmium, and the lowest pH. Although to date, the pH is still low, on average it has been increasing, thus improving. In 1993, cadmium hit a peak in well 31A of 1.480 mg/L but has steadily decreased. Chromium concentrations were greatest at monitoring well 19 with a maximum concentration for 1992 of 0.922 mg/L. As illustrated, these concentrations have steadily decreased. Copper concentrations were greatest at monitoring well 31A and the SID system and decrease sharply south of the SID system. Maximum copper concentrations in 1994 and 1992 were 205 mg/L and 177 mg/L for well 31A and the SID system, respectively. The average copper concentration has been decreasing. Zinc concentrations were greatest in monitoring well 31A and the SID system, with maximum concentrations for 1994 and 1992 of 88 mg/L and 32.0 mg/L, respectively. A maximum nickel concentration for 31A of 140 mg/L was recorded in 1994. Maximum lead concentrations are found at wells 31A and 19 and the SID system, with maximum concentrations in 1992 at these locations of 1.11 mg/L, 0.65 mg/L, and 0.92 mg/L, respectively. A maximum concentration of Arsenic was reported in 1995 in well 31A of 1.44 mg/L.

Although it has been concluded that groundwater downgradient of the SID system is not controlled by the SID system, the system is effective in providing source control and limiting further downgradient migration of contaminated groundwater.

Downgradient wells, 16, 19, 25, 28, and 29 all show signs of improving water quality.

Data from the latest sampling round (third quarter) to include the new wells installed in 1997 is included in Appendix 3-4. The maximum cadmium concentration of 1.19 mg/L was in well 27 which is located along the SID system. Chromium was not detected above the 35 Ill. Admin.. Code 620 groundwater standard of 0.1 mg/L. The maximum copper concentration of 70.1 mg/L was detected in well 53 located just east of the SID system. Maximum nickel and zinc concentrations of 185 mg/L and 11.9 mg/L, respectively, were recorded in well 28. The maximum lead and arsenic concentrations were detected in well 31A at 0.26 mg/L and 0.402 mg/L, respectively.

In summary, the highest concentrations of hazardous waste constituents in the shallow, perched aquifer occurred near the former floor wash impoundment, which has not been in use since 1981. The constituents of concern consist of the metals copper, arsenic, cadmium, lead, chromium, nickel, and zinc with associated low pH. Since monitoring began in 1983, metals concentrations have decreased substantially. The SID system continues to remove water contaminated with metals and prevent discharge of contaminated water to the sand lense outcrop area.

3.5.2 Groundwater Quality of the Regional Aquifer

Upper Zone of the Regional Aquifer

Table 3-2 presents results of the pH, TDS, chloride, boron and metals (copper, zinc, cadmium, chromium, lead, arsenic, and nickel) analyses of wells screened in the upper zone of the regional aquifer. Concentrations included are averages for the year unless noted in the table. Comparison of these analytes in wells screened in the upper zone of the regional aquifer to wells screened in the aquitard shows a significant reduction in the concentrations of these compounds in the regional aquifer with an accompanying increase in pH.

The median concentrations of copper, nickel, cadmium, chromium, lead, arsenic, and zinc in the upper zone of the regional aquifer range from one to three orders of magnitude below the median of these metals in the aquitard. The concentrations of the metals varied throughout the wells sampled, within approximately one to two orders of magnitude. The variations, however, were inconsistent between wells and between sampling rounds.

In 1988, the review of the well construction techniques led to the conclusion that, because the sand packs of the wells screened in the upper zone of the regional aquifer extended into the aquitard, these sand packs may be a pathway for groundwater containing metals to enter the regional aquifer. To test this hypothesis, wells 31, 32 and 33 were installed and sampled. The analysis of these samples has not shown a distinctively different water quality than other wells located in the same areas.

Even though sampling has not proven that the sand packs are pathways for groundwater movement, Chemetco has abandoned four wells (2, 4, 5 and 8) which appeared to be constructed improperly. Other abandoned wells are mentioned in Section 3.2.I. Wells 2, 4, 5, and 8 were not replaced; other wells are located in their general proximity: well 31 near well 2, well 32 near wells 4 and 5, and well 33 near well 8.

Data summaries from the latest sampling round (third quarter) in 1997 to include the new wells installed in 1997 are included in Appendix 3-4. Maximum concentrations of arsenic and nickel at 0.22 mg/L and 0.12 mg/L, respectively, were detected in well 38R. Chromium, copper, and zinc were not detected above the appropriate and applicable 620 groundwater quality standard. A maximum concentration of cadmium of 0.008 mg/L was recorded in well 44R. It should be noted that the new background well, 51, provided analytical results for lead and cadmium of <0.05 mg/l and 0.006 mg/l, respectively, that were above the 620 standards. This type of data could be indicative of an off-site source or a higher than normal, naturally occurring background. Additional sampling will improve our understanding of this situation as it will be further evaluated in upcoming annual reports.

Lower Zone of the Regional Aquifer

Chemetco's two water supply wells are both screened in the lower zone of the regional aquifer; these water supply wells have been sampled and the results of these analyses are included in Appendix 3-4. The analytical results show that the water from these water-supply wells is potable and that none of the analytes of concern have been detected at significantly elevated concentrations.

Water sample analyses from former wells 36, 39, 43 and 46, screened in the lower zone of the regional aquifer have median concentrations of cadmium, chromium, copper, lead and zinc of <0.005 mg/L, <0.010 mg/L, 0.098 mg/L, 0.025 mg/L, and 0.038 mg/L. These are the median concentrations for all analyses of wells 36, 39, 43 and 46 sampled quarterly between 1992 and 1996. All of the above concentrations are below Ill. Admin.. Code 620 Class I groundwater quality standards with the exception of lead. For the most part, lead has been at or below concentrations of .007

mg/l Pb in all wells except 39. Therefore, further investigation regarding the well's integrity occurred.

Maximum metal concentrations from groundwater analyses of wells 36, 39, 43 and 46, occurs in well 39. During the 2nd quarter 1992, it was noted that the protective casing on well 39 was broken, and the well was constructed so that runoff water could potentially drain down the well. A new flush-mount protective casing and concrete apron were installed to divert water away from the well head. Chemetco believes that surface runoff water could be responsible for the elevated levels of metals in well 39. If so, concentrations should decline as contaminated surface water is dispersed in the prolific lower regional aquifer. The maximum concentrations at well 39 for cadmium, chromium, copper, lead and zinc are <0.005 mg/L, <0.010 mg/L, 0.649 mg/L, 0.600 mg/L, and 0.255 mg/L, respectively. As agreed to in the Response to Comments dated March 21, 1997 regarding the "Hydrogeologic Evaluation, Chemetco, Inc.", a Compliance Monitoring Program in compliance with 35 Ill. Admin.. Code 724.199 will be conducted on the Lower Regional Aquifer until such time as background well 52 is installed and background concentrations have been established. Well 52 was installed April 15, 1997 and background sampling is being performed. Also, Well 36 and 39 have been replaced with 36R and 39R due to well integrity issues.

The third quarter 1997 groundwater sampling results recorded a concentration of 0.014 mg/l of lead in well 39R.. Although still above the 620 groundwater standard, it is quite a bit lower than the maximum of 0.600 mg/l. All other wells sampled, 36R, 52 (background well) and 53, were <0.005 mg/L. The only other constituent detected above its 620 standard was cadmium in well 52 (background well) at 0.006 mg/l.

3.5.3 Other Constituents

The results of 40 CFR 261 Appendix VIII and 40 CFR 264 Appendix IX analyses of wells 22 and 31A in May and August 1989 indicated the presence of only a few constituents. Five semi-volatile organic and two volatile organic compounds were positively identified, but at concentrations below detection limits. Two pesticides, aldrin and beta - BHC were present at 0.17 and 0.67 micrograms per liter (ug/L) respectively and two volatile organic compounds, trichloroethane and carbon disulfide, were detected at 5 and 6 ug/L respectively. Given that the Chemetco facility is located in an agricultural area, the presence of pesticides in the aquitard groundwater is expected. The source of the volatile organic compounds is not known at this time; the low concentrations indicate that these compounds should not be of concern.

40 CFR 261 Appendix VIII and 40 CFR 264 Appendix IX analyses of impoundment material reveal the presence of aldrin in the zinc oxide impoundment and methylene chloride, a common laboratory contaminant, in both the floor wash water impoundment and the zinc oxide impoundment. Neither aldrin nor methylene chloride are used by Chemetco; detection of these constituents indicates contamination external to the facility.

In June 1987, analyses of groundwater from wells 1A, 2B, 3A, 8, 8A, 11, 11A, 19, 20 and 21 for inorganic parameters, pesticides, and bacteriological and radiological parameters detected no compounds or parameters outside the expected range for drinking waters except for the compounds discussed above in the water quality sections (metals and related water quality indicators).

In December 1992, October 1993, October 1994, October 1995, and October 1996, wells 28, 31A (perched aquifer), 34, 44 and 47 (upper zone of the regional aquifer) were sampled for Appendix I metals and semi volatiles. All semi volatile constituents were below detection limits.

3.6 General Monitoring Program Requirements: 724.197

The groundwater monitoring program was developed based on the site specific hydrogeology and water quality information gathered over the course of almost fourteen years of field investigations. The program is designed to meet Federal (40 CFR Part 264, Subpart F) and Illinois (35 IAC, Subtitle G, Part 724, Subpart F) requirements in accordance with the Chemetco and IEPA closure negotiations. The program is described in detail in Section 3-9.

3.6.1 Description of Wells: 724.197(a) and ©

Refer to Section 3.2.1.

3.6.2 Description of Sampling Analysis Procedures: 724.197(d)

Refer to Section 3.2.2.

3.6.3 Procedures for Establishing Background Quality: 724.197(g)

Chemetco proposes to evaluate water quality with respect to cleanup objectives as specified in Section 3-9.

3.6.4 Statistical Procedures: 724.197(h)

Chemetco will propose a statistical method in the annual report due March 1, 1998 to be utilized with future background data.

A trend analysis will be used to evaluate concentration trends versus time at all shallow wells. This nonparametric test is appropriate because the data need not conform to any distribution, and not-detected values can be included by assigning them a common value that is lower than the lowest detected value. Not-detected values will be assigned a number one half the detection limit, the value of which will vary depending on the compound being tested. The null hypothesis H_0, of no trend will be tested against the alternative hypothesis H_A, of an upward trend. A type I error level of 0.01 will be used for hypothesis testing. The use of this test in the context of monitoring the groundwater management zone is discussed in Section 3-9.

3.7 Detection Monitoring Program: 703.185(f), 724.198

All wells will be in compliance monitoring/corrective action. This section is not applicable.

3.8. Compliance Monitoring Program: 724.191(a)(l), 724.199

As discussed in Section 3.2.3, hazardous waste constituents were detected in groundwater in 1983 in the perched aquifer, at which time assessment monitoring was initiated. In addition, corrective action activities are currently being conducted for groundwater at the facility. Because hazardous waste constituents have been detected in groundwater, the monitoring program being implemented under 35 Ill. Adm. Code

724.200 (corrective action) will also serve as the compliance program under 35 Ill. Adm. Code 724.199 (compliance monitoring) for the Post-Closure period. Once the corrective action has been completed, the monitoring program will be used strictly for compliance purposes. Assuming the groundwater at the facility is designated a groundwater management zone under 35 Ill. Adm. Code 620.250, compliance with specified concentration limits will not be applicable until the cessation of corrective action measures. Elements of the compliance program will still be useful during corrective action, however, to track progress toward cleanup and the effectiveness of the corrective action.

3.8.1 Description of Monitoring Program: 724.199(a)

A description of the compliance monitoring program to be followed during the post closure period is included in the groundwater monitoring program described in Section 3.9.5.

3.8.1.1 Waste Description: 724.199(a)(l), 724.193(a)

Currently, four primary materials are generated by Chemetco's process operations: copper anodes, crude lead-tin solder, zinc oxide, and slag. All four co-products are sold commercially. The co-products generated at the Chemetco facility consist solely of inorganic metallic and non-metallic constituents. The only groundwater contaminants expected to be derived from this waste are dissolved metals. Specific contaminants found in the groundwater are described in Section 3-5.

3.8.1.2 Characterization of Contaminated Groundwater: 703.185(g)(2)

Groundwater contamination at the facility is well characterized by the existing well network. Refer to the contaminant plume description and associated contaminant plume maps in Section 3-5.

3.8.1.3 Hazardous Constituents to be Monitored in the Compliance Program: 724.199(g), 724.193.

Chemetco will monitor the perched and regional aquifers for concentrations of metals and semi-volatiles listed in IEPA's January 29, 1993 approval letter. Refer to Section 3.9.5.5 for the list of constituents, frequency of sampling, and wells to be sampled.

3.8.1.4 Concentration Limits: 724.194(a), 724.199(a)(2)

Concentration limits are discussed in Section 3.9.2.

3.8.1.5 Alternate Concentration Limits: 724.194(b)

Not applicable

3.8.1.6 Engineering Report Describing Groundwater Monitoring System: 703.185(e)

The proposed monitoring programs for compliance monitoring and corrective action is discussed in Section 3.9.

3.8.1.7 Proposed Sampling and Statistical Analysis Procedures for Groundwater Data: 724.199(c)

The method for sample analysis is included in Appendix 3-7 (Section 3.2.2). The proposed method for the statistical analysis of groundwater quality is presented in Section 3.6.4.

3.8.1.8 Groundwater Protection Standard Exceeded at Compliance Point Monitoring Well: 724.199(h)

As discussed in Section 3.9.2, Chemetco is proposing to define a groundwater management zone at the facility, which will defer reporting of point of compliance exceedences until cessation of corrective action measures. Upon completion of corrective action measures, the determination of exceedences of concentration limits at the point of compliance will be reported to IEPA as required under Section 724.199(h).

3.9 Corrective Action Program: 724.200, 724.191(a)(2) and (3)

Chemetco voluntarily constructed the SID system in 1984 as a corrective action measure to prevent off-site migration of hazardous waste constituents after assessment monitoring indicated contamination in the perched aquifer. This section describes the corrective action measures that have been undertaken at the facility (Section 3.9.4) and the Corrective Action Monitoring Program (Section 3.9.5).

3.9.1 Characterization of Contaminated Groundwater: 703.185(h)(l)

Groundwater contamination at the facility is well characterized by the existing well network. Refer to the contaminant plume description in the shallow aquifer/aquitard from the 3rd Quarter 1997 Quarterly Report included as Figure 3-14.

3.9.2 Concentration Limits: 724.194(a), 724.000(b)

Under 35 Ill. Adm. Code Part 620 regulations, groundwater of the State may be designated as a groundwater management zone (GMZ)(Section 620.201). Monitoring of the GMZ during the corrective action period is discussed in revised Section 3.9.5.3. Under Section 620.250(c), upon completion of corrective action measures the facility will be required to meet the groundwater cleanup objectives described in 620.450(a)(4)(B). Under 620.450(a)(3) cleanup objectives are not applicable to released hazardous waste constituents within the GMZ prior to completion of corrective action. It is Chemetco's understanding that although continued progress toward achieving cleanup objectives and the effectiveness of the corrective action measures must be reported periodically to the Agency, there will be no required actions in response to exceedences of groundwater quality limits within the groundwater management zone while the corrective action measures are ongoing.

The perched aquifer and the regional aquifers are Class I aquifers under 620.210 as previously determined in Chemetco's October 1992 Closure Plan Modification Request to the Closure Post-Closure Permit Application. The groundwater quality objectives as stated in 620.410 for the applicable metal constituents for a Class I potable resource groundwater are:

Constituent	Objective (mg/L)
Arsenic	0.05
Cadmium	0.005
Chromium	0.l
Copper	0.65
Lead	0.0075
Nickel	0.1
Zinc	5.0
pH	6.5 - 9.0

Chemetco understands that these standards are the cleanup objectives required for completion of corrective action measures.

3.9.3 Alternate Concentration Limits: 703.185(h)(2), 724.194(b), 724.199(a)(2)

Not applicable

3.9.4 Corrective Action Plan: 703.185(h), 724.199(h)(2), 724.200(b)

Perched Aquifer/Aquitard

As a result of the finding of groundwater contamination in the shallow perched zone, Chemetco initiated investigations into the extent of the contamination and studied potential remediation measures. In early 1984 an acid recovery trench was installed south of the facility and contaminated groundwater recovered. Chemetco installed a subsurface interceptor drainage (SID) system in mid-1984.

The SID system is located just south of Oldenberg Road in the vicinity of former monitoring wells 16, 17, 18 and 13. The system consists of two lengths of six inch diameter perforated PVC drainage pipe laterals which extend 235 feet east and 367 feet west from a buried stainless steel tank. The tank, acting as a temporary accumulation pump, is approximately six feet in diameter, twenty feet long and is buried vertically. The collector lines are nine feet below grade in the center and seven feet below grade at the ends, both of which are capped. The drainage pipes are at an elevation of 412 feet at the ends and 410 feet at the center; this is also the groundwater elevation of the perched aquifer in the vicinity of the SID system. The collector lines slope to permit gravity flow of captured water into the pump at a depth of about twelve feet. Approximately seven feet of sump remains below the point where the laterals are connected.

The lateral pipes were installed in a two foot side trench which was lined on the bottom and downgradient (south) with 20 mil impermeable polyethylene liner. The pipes were wrapped in filter fabric and set on a bed of approximately nine inches of clean Meramac gravel and covered with about three feet of the same gravel. The gravel and piping were installed such that the top of the gravel pack lies at the base of the shallow perched zone. Therefore, the trench extends downward approximately three and one-half feet into the confining layer underlying the shallow perched zone. The trench was then backfilled with crushed silicate slag to within a few feet of the surface and finished with the excavated native material. The collector pipes (laterals) are equipped with exposed six inch diameter clean out pipes spaced at approximately 80 foot intervals.

Water flowing to the pump via the collector pipes is pumped back to the

Chemetco facility by a surface mounted suction pump. The pump is automatically activated when the water level in the pump reaches 14 feet from the surface and shuts off when the level drops back to 17 feet. The level-activated pump ensures that the water level in the pump remains below the laterals, permitting full gravity drainage of the laterals to collect contaminated groundwater. The water pumped from the pump is discharged into the "AAF Scrubber System" (Polish Pits) where the water is used in the production of zinc oxide.

The effectiveness of the SID system was evaluated using a conceptual model of the system operation, a water balance, and available water quality data. The results are reported in the January 1991 report entitled "Hydrogeologic Summary, Chemetco Inc. Facility, Hartford, IL". Specifically, the report presents the system's purpose (and design), provides a conceptual model of how the SID system operates, and reports on the system's effectiveness. Calculations showed that the volume of water withdrawn from the SID system correlates well with the volume of water flowing through the sand lenses.

As described above, the SID system, installed as a passive system to collect all the groundwater flowing through the sand lenses, was constructed spanning the full width and depth of the perched sand lenses in the area. The SID system was not designed to nor is it recovering groundwater downgradient of the SID system. The SID system was installed in the area where the sand lense crops out. The sand lense pinches out south of the SID system trench.

A hydrogeologic evaluation was conducted by CSD in June 1995. One of its objectives was to determine the effective limit of remediation from the SID system in order to establish a groundwater monitoring zone for the shallow sand lense under 35

Ill Admin.. Code , Part 620.

Groundwater elevations were collected on July 31, 1995 from monitoring wells 16, 19, 27, 28, and 29 immediately downgradient of the SID system. Groundwater elevations were also taken from the four risers, labeled risers 1 through 4, of the SID system on July 31, 1995. Table 3-4 summarizes the groundwater elevations at each well and riser. Figure 3-15 is a cross sectional view of groundwater within the SID system.

Groundwater elevations collected from the riser pipes within the SID system were higher than the groundwater elevations collected from the wells located immediately downgradient of the SID system. It is concluded that groundwater downgradient of the SID system is not controlled by the SID system. However, the SID system is effective in providing source control and limiting further downgradient migration of contaminated groundwater. Trend analysis conducted on wells downgradient of the SID system is effective in remediating contaminant levels in the shallow aquifer. Downgradient wells, 16, former well 19, 28, and 29 all show signs of improving water quality. Only well 27 downgradient of the SID system failed to show significant improvement. The linear regression slopes for metal concentrations in this well were half positive and half negative, indicating the potential impact of operations of the facility on the groundwater has stabilized.

Table 3-5 summarizes the exceedences above the Part 620 groundwater quality standards found in 1994 downgradient of the SID system. Initially CSD proposed installation of additional recovery wells downgradient of the SID system to expand the effective limit of the corrective action program, however, review of the boring logs from downgradient wells indicated the shallow sand lense extends only 100 to 150 feet south of the SID system. Installation of additional recovery wells for this small area does not appear warranted. Trend analysis shows the water quality in this area is improving and although this area is not proposed to be part of the GMZ, monitoring of the constituent levels will continue. Monitoring of wells 16, 27, 28, and 29 is proposed in lieu of implementing additional corrective action activities at this time. At the time of completion of the corrective action, the groundwater quality upgradient and downgradient of the system will be compared to the appropriate groundwater quality standard. If levels remain above the standard, Chemetco may pursue an alternative groundwater standard under 35 Ill. Admin.. Code 620.450.

Regional Aquifer

In the course of closure negotiations during 1988, Chemetco agreed to control offsite migration of groundwater in the upper zone of the regional aquifer. At the time this agreement was made, little to no data was available on the groundwater quality of the regional aquifer.

Consequently, Chemetco used a mathematical model to design a gradient control system which would prevent the off-site migration of groundwater in the upper portions of the regional aquifer. The design called for the installation of 4 pumping wells. Two of the four pumping wells, Pumping Wells B and D, proposed for the gradient control system have been installed by Chemetco.

Pumps have not been placed in either of the wells to initiate pumping. In 1994 linear regression trend analysis was conducted using groundwater data including three quarters of 1992 and four quarters of 1993. The results of the linear regression trend analysis and recent potentiometric maps for the regional aquifer indicated that the corrective action program currently in operation (SID system and on-site process wells) is generally effective for all three aquifers being monitored. Only two wells 11A and 47 were considered problematic in terms of trend analysis. One of these wells 11A is considered as a "background" well for the shallow aquifer. Increasing contamination trends (As, Cu, Pb, Sn, Zn, SC, and Ni) in this well did not appear to be related to the units at Chemetco. 11A has recently been abandoned and a new well, 56, has been installed. The results of sampling will be included in the quarterly report for the fourth quarter 1997. The results of the second well, 47 were difficult to interpret. Increasing contaminant trends were apparent in this well (As, Cd, Cr, Cu, Pb, Sn, TOC and Zn), but it does not seem likely that the source of contamination was from any of the units at Chemetco. This well has recently been replaced with 47R due to concern over well integrity. The results of the trend analysis confirmed the SID system is effective in remediating the regional aquifer, by removing the source from the perched aquifer and significantly reducing the downward migration of contaminants. It appears additional remediation efforts, i.e., initiating pumping of the regional aquifer is not warranted at this time. CSD and the IEPA have previously discussed this item and agreed to first install the background well for the Upper Regional Aquifer. Well 51 was installed this past summer. If it is determined after background has been established that the Upper Regional Aquifer has been impacted, CSD will provide the Agency with additional information requested in its letter dated March 14, 1997 regarding the "Hydrogeologic Evaluation, Chemetco, Inc.".

As requested in the January 29, 1993 approval letter, Chemetco will:

- Ensure the effectiveness of the SID system. From the quarterly groundwater elevation data, flow rate and direction will be determined and water table and piezometric maps will be developed for the perched and regional aquifer. Maps will show facility boundaries and the location of wells used to develop the maps. Results will be reported to IEPA in semi-annual groundwater monitoring reports;

- Record rates of water removal for the SID system and include the data in the semi-annual reports to IEPA; and

- Submit a report to IEPA annually discussing the effectiveness of the corrective action program. This report will address (l) the ability of the program to control groundwater gradient and, (2) the statistically significant increase or decrease in groundwater quality during operation of the corrective action program. This report will be submitted to IEPA by March 1 annually as required under 35 Ill. Adm. Code Part 725.194 until background has been established and semi-annually thereafter.

3.9.4.1 Location: 724.200 (e)(l)

The SID system will continue to remove metals from the aquitard to prevent discharge to the outcrop zone. Thus, the locations of corrective action measures are sufficient for protection of human health and the environment.

3.9.4.2 Construction Detail: 703.185(h)(3)

The construction details for the SID system are described above in Section 3.9.4.

3.9.4.3 Plans for Removing Wastes: 724.200(b) and (e)

Since the SID system has been in operation it has contributed to the reduction in metal contamination from the perched aquifer as evidenced by two SID system samples from early operation, and 1992. A sample collected on June 22, 1984 contained 1292 mg/L Copper, 2.74 mg/L Lead, and 140 mg/L Zinc while a sample collected October 31, 1992 contained 177 mg/L Copper, 0.92 mg/L Lead, 32.0 mg/L Zinc. The latest sample from July 1997 contained 60.2 mg/L Copper, 0.07 mg/L Lead, 22.2 mg/l Zinc. As indicated on Table 3-1, metals concentrations in wells screened in the perched aquifer have also decreased substantially since the SID system began operation. This demonstrates that the SID system is removing hazardous waste constituents from groundwater.

3.9.4.4 Treatment Technologies: 724.200(b) and (e)

The contaminated groundwater withdrawn during corrective action will be used in the facility's manufacturing processes.

3.9.4.5 Effectiveness of Correction Program: 703.185(h)(4), 724.200(d) & (g)

Chemetco will be collecting groundwater elevation measurements and water quality samples to evaluate the effectiveness of the corrective action measures. This issue is discussed in detail in Section 3.9.5.

3.9.4.6 Reinjection System: 703.185(h)(3), 724.200(b)

Chemetco's corrective action program does not call for a reinjection program.

Should Chemetco decide on a reinjection program in future, plans will be submitted to IEPA for review and approval.

3.9.4.7 Additional Hydrogeologic Data: 703.185(h)(3), 724.200(d)

Additional hydrogeologic data is not required at this time. The existing network of monitoring wells is sufficient for monitoring the effectiveness of the corrective action, and progress toward achieving cleanup objectives.

3.9.4.8 Operation and Maintenance: 703.185(h)(3), 724.200(b)

All equipment associated with the withdrawal of water from the perched aquifer will be properly maintained by Chemetco. Equipment failures will be reported in writing to the Permit Section, Division of Land Pollution Control within seven days of the failure along with descriptions of actions taken to ensure compliance with the requirements of the corrective action program.

Monitoring Well Maintenance Program

Due to the potential deleterious effects of nature on monitoring wells and their protective casings, the elevation of the measuring point at each well will be resurveyed at a minimum interval of every two years. All wells were recently resurveyed in September 1997. Surveying will be done by an Illinois licensed surveyor using standard techniques to determine elevation. Elevations will be measured to the nearest 0.01 feet. Survey results were provided in Chemetco's Third Quarter report dated October 1997. New survey elevations for each well were used to calculate groundwater elevations from the depth to water measurements.

All monitoring wells will be inspected each time a sample is taken for the condition of the well label, the protective casing, and the seal apron. Condition of monitoring wells shall be recorded on the field sampling forms. The designation of each monitoring well (MWx) will be written and painted in indelible ink or paint on each protective casing. The condition of the surface seal around the protective casing will be inspected annually for deterioration or cracking and repairs will be made as necessary. The grading of surface soils around each monitoring well will also be inspected to ensure that rainwater cannot pond around the protective casing.

Subsurface Interceptor Drainage (SID) System Maintenance Program

An operation and maintenance program for the SID system has been developed to prevent problems with incrustation of system components, namely scale buildups on the surface-mounted suction pump and drainage-pipe laterals. All maintenance work will be performed during the third quarter of the calendar year. A description of the maintenance work performed will be included in the following semi-annual assessment report.

Work described below will be performed biannually. Chemetco will initiate regular inspection and maintenance of the surface mounted suction pump and associated equipment to prevent the buildup of scale from hindering removal of water from the SID system water storage tank. The pump, intake pipes, and discharge pipes will be inspected and any scale buildup will be removed. Chemetco will also initiate regular maintenance of the drainage pipe laterals to ensure continued removal of water from the perched aquifer. These laterals will be inspected and cleaned via clean out pipes if necessary.

3.9.4.9 Closure and Post-Closure Plans: 703.185(h)(3), 724.200 (b)

Closure Post Closure care plans for the regulated units are discussed in Revised Post Closure and Closure Plan, June 1994, Sections 4, 5, 6 and 7.

3.9.5 Groundwater Monitoring Program: 703.185(h)(4), 724.192,724.200(d)

3.9.5.1 Purpose

The groundwater monitoring program for the facility will be used to satisfy the requirements of 724.200(d), 724.199, and 620. The objectives of the groundwater monitoring program for the Chemetco facility are as follows:

- demonstrate the effectiveness of the SID system as required under 724.200(d) by means of groundwater elevation, flow rate, and water quality data;
- monitor the downgradient edge of the groundwater management zone throughout the post-closure period;
- track the rate and extent of contaminant migration in groundwater, and
- monitor groundwater quality trends throughout the post-closure period; and
- following corrective action, confirm achievement of groundwater cleanup

objectives at the defined points of compliance as required under 724.199.

Both hydraulic and water quality data are necessary to evaluate the performance of the SID system. Data used will include measurements of hydraulic head, measurements of flow rates from the pumping wells, and water quality data. Performance is also determined by measuring the quality of the groundwater pumped from the SID system) to verify that the system continues to extract hazardous waste constituents.

To monitor compliance under 724.199(a), only groundwater quality data are required. The point of compliance is strictly defined as a vertical surface that extends down into the uppermost aquifer and runs along a line located immediately downgradient of a surface impoundment. However, due to the complexity of the hydrogeology at this site, multiple points of compliance are proposed for this facility. The point of compliance for the upper zone of the regional aquifer has been established as the 40 acre plant boundary, and is monitored by wells 44R, 47R, 48, 37R, 38R, 49, 50, and 55 will be utilized to monitor the GMZ for the Upper Regional Aquifer. Well 51 will monitor background quality of the Upper Regional Aquifer. Chemetco proposes to collect groundwater quality data from these wells on a semi-annual basis after the establishment of background.

The point of compliance for the perched aquifer is located immediately downgradient of the former floor wash impoundment and is monitored by wells 31A and 54. Points of compliance are included as Figures 3-11, 3-12, and 3-13.

The groundwater monitoring program addresses the entire facility; however, due to the complex site-specific hydrogeology, separate points of compliance were established for the shallow perched aquifer and the regional aquifer. Chemetco is proposing that the groundwater beneath the site be established as a GMZ during the post-closure period.

This program was originally proposed in the approved Closure Plan submitted to IEPA in January 1991. The program was approved with conditions in an April 19, 1991 letter. These modifications were addressed by Chemetco and another IEPA approval letter with conditions was issued on January 29, 1993. This letter also approved the document entitled "Chemetco Closure Plan Modification Request" submitted to IEPA in October 1992 which addressed Appendix I sampling issues. Both of the above letters are included in Appendix 3-3. Chemetco also submitted a document entitled "Hydrogeologic Evaluation" dated November 1995 and the "Response to Comments, Hydrogeologic Evaluation" dated March 1997. The monitoring program proposed in this closure-post closure revision incorporates all of the IEPA concerns listed in the above-referenced correspondence. This document has also been revised to incorporate changes to the monitoring system, monitoring data obtained between 1992 and the present, and the data collected and previously presented to the Agency in "Hydrogeologic Evaluation, Chemetco, In." dated November 1995. However, reporting requirements under 724.200(g) are different than those under interim-status, Chemetco is modifying the existing program in some respects to conform to 724.199, 724.200, and 620 requirements. Wells proposed for sampling and water elevation measurements are listed in Table 3-6. The wells will be sampled for the hazardous waste constituents listed in Section 3.9.5.5.

3.9.5.2 Reporting Requirements

Given that there is no requirement under 35 Ill. Adm. Code 724.197(i) regarding reporting frequency and that there is a requirement under 35 Ill. Adm. Code 724.200(g) to report on the effectiveness of the corrective action measures at least semi-annually, Chemetco proposes to change the water quality sampling and groundwater elevation collection and reporting frequency (from the quarterly reporting required under interim status) to twice each year once background has been established. Semi-annual groundwater quality monitoring will be conducted in April and October of each calendar year (i.e., 2nd and 4th quarters). Semi-annual assessment reports will be submitted after the 2nd and 4th quarters, on July 15 and January 15, respectively.

Chemetco also proposes to measure flow rates weekly from the SID system rather than daily as indicated in the January 29, 1993 closure plan approval letter. Chemetco believes that weekly flow rate measurements will be adequate for documenting withdrawal rates and monitoring the performance of the extraction system.

The semi-annual reports will present the results of semi-annual groundwater quality sampling and analysis, semi-annual water level monitoring data including potentiometric maps, and flow rate data collected from the groundwater extraction system as well as information on the effectiveness of the corrective action measures as required under 35 Ill. Adm. Code 724.200(g), and progress toward achieving cleanup goals. Maintenance activities will be reported in each semi-annual report as necessary. Other information such as survey data will be reported as necessary. The annual report, required under interim status, will be superseded by the two semi-annual reports. The semi-annual report due July 15 will also include statistical analysis and isoconcentration maps.

3.9.5.3 Perched Aquifer Monitoring Program

Water level data indicate that water in the sand and silt lenses in the perched aquifer flows in a southerly direction. As discussed in detail in Section 3-5, groundwater in the perched aquifer contains elevated concentrations of lead, cadmium, zinc, arsenic, chromium, copper and tin and low pH. Based on analytical data and knowledge of Chemetco processes, the constituents of concern in the groundwater in the perched unit are solely inorganic. As discussed in Section 3.9.4 Chemetco responded to the detection of metals in the perched aquifer by implementing a passive recovery system (the SID system) to intercept groundwater. The system was designed to intersect the entire column of water-bearing sand and silt, thereby completely intercepting the contaminated water. The areal extent of the water-bearing unit is well within the Chemetco property. Therefore, there is no potential for offsite migration of the contaminated water. The compliance monitoring program, described below, was designed to track the distribution of hazardous constituents and monitor progress toward meeting cleanup objectives, to measure the effectiveness of the SID system, and to monitor the GMZ boundaries.

Information on the well elevations and former designations are provided Table 3-3. Wells 56, 16, 19R, 27, 28, 29, 31A, 54 and 41 will be sampled for the hazardous constituents listed in Section 3.9.5.5 as listed in Table 3-6. Chemetco is proposing that these wells be sampled semi-annually. The locations of these wells are shown on Figure 3-I. Chemetco is proposing at this time to only monitor wells 31A and 54 on a semi-annual basis once background has been established at the point of compliance until such time as the wells monitoring the GMZ boundary indicate the quality of the groundwater has improved to the point to warrant shutting the recovery system down.

Chemetco will measure groundwater elevations in the wells listed above plus 15, 25, and 12 on a semi-annual basis. These wells have been added for groundwater elevation measurements so that a more complete groundwater flow map of the perched aquifer can be developed.

Groundwater Management Zone (GMZ)

As indicated in Section 3.9.2, Chemetco believes that the groundwater at the facility meets the criteria specified in Section 620.250(a) for designation as a groundwater management zone (GMZ). A GMZ is defined as "a three dimensional region containing groundwater being managed to mitigate impairment caused by the release of contaminants from a site". The facility is currently conducting corrective action measures that have been approved by the Agency, and the plume configuration and perched aquifer boundaries have been adequately characterized such that a three dimensional management zone can be established.

Existing data indicates that the perched aquifer, as shown in map view in Figure 3-5, and in cross section in Figure 3-6, is bounded in three dimensions by low hydraulic conductivity aquitard material ($K = 4.6 \times 10^{-5}$ cm/sec). Chemetco proposes that the GMZ for the perched aquifer correspond to the western, northern and eastern boundaries of the perched aquifer as shown on Figure 3-11. In order to monitor the groundwater quality in the most downgradient portion of the GMZ, Chemetco proposes to define the southern boundary of the GMZ with wells rather than using the physical extent of the perched aquifer. The southern boundary of the GMZ will correspond to the line of wells defined by wells 27, 16, 28, and 29. These wells were chosen because they are close to the southern boundary of the perched aquifer but are still screened in the aquifer as opposed to the aquitard. Wells 27, 16, 28, and 29 are proposed as a boundary for the GMZ despite having elevated metals concentrations. The definition of a GMZ by clean wells is not possible in this case since all wells in the perched aquifer contain metals. A clean well boundary would require the use of wells screened in the aquitard; however, wells screened in the aquitard would not be hydraulically connected to the aquifer and cannot be used to evaluate water quality of the aquifer.

Wells 27, 16, 28, and 29 will be used to monitor the GMZ boundary despite containing metals because water analyses from these wells show declining trends in metals concentrations over time. With the installation of the SID system, wells 27, 16, 28, and 29 should have been hydraulically disconnected from the source of metals contamination. Continued decreases in metals concentrations in these wells will confirm the disconnection from source contamination and therefore will also support the effectiveness of the SID system. If trends continue downward, Chemetco will conclude that the SID system is effectively recovering all contaminated groundwater and no further actions will be taken. If upward trends are observed, it may be concluded that hazardous constituents are exiting the GMZ and Chemetco will evaluate the need for further efforts. A trend analysis will be used determination.

The upper and lower boundaries of the GMZ are the physical extent of the perched aquifer; overlain and underlain by the silty clay of the aquitard. Water quality trends in wells in the upper zone of the regional aquifer may also be used to determine whether or not metals are migrating vertically (out of the GMZ) to this aquifer.

Groundwater in several of the point of compliance wells presently contain elevated metals concentrations; however, under 620.450(a)(3) cleanup objectives are not applicable to released hazardous waste constituents within a GMZ prior to completion of corrective action.

Subsurface Interceptor Drainage System

The effectiveness of the SID system will continue to be assessed independently of the point of compliance. Chemetco proposes to use analytical results from upgradient well 31A and downgradient wells 27, 16, 28, 29 to evaluate the system.

The extent of contamination migrating from the suspected source area toward the SID system will be monitored by well 31A. Well 31A was installed immediately downgradient of the southernmost closed unit. Constructed of stainless steel, the well was intended to provide data on the potential leaching of organic compounds from the closed unit to the groundwater in the shallow perched zone. It also quantified metal concentrations in groundwater upgradient of the SID system. Well 31A will be monitored as an indicator of the water quality in closest proximity to the source area.

The effectiveness of the SID system will also continue to be assessed based on the quality and volume of the water pumped from the system.

Southeastern Quadrant

The distribution of constituents of concern east of the southeastern facility boundary will be monitored using data collected in wells 41 and 19R on a semi-annual basis once background has been established. Well 12 is located in an area of known contamination and will be monitored for water levels only; minor elevated concentrations of constituents of concern have been detected in wells 41 and 19R.

Water level data indicate that well 12 may be screened in a different sand lense than the lense that extends south of the facility fence line; data indicate that clay separates the two water-bearing strata. Based on hydrogeologic interpretation of available data, the contaminated water detected in well 12 is flowing south-southeast in a small local unit which may or may not extend southeast of well 12. Wells 41 and 19, have groundwater elevations between the perched zone and the regional aquifer. This difference in water level elevations and the nonexistence of sand lenses between these two areas as shown by former well 13 and well 18, indicate that the sand lenses to the east of Well 12 are isolated from the contaminated perched aquifer. Trend analysis prepared from the 1992 and 1993 quarterly groundwater monitoring does not indicate any apparent increase in metals concentrations in wells 29 or 41 which bolsters the case for non-interconnection between the two sand units.

3.9.5.4 Regional Aquifer Monitoring Program

Data collected on the regional aquifer indicate that the groundwater flow direction varies depending upon Mississippi River Stage and groundwater withdrawal through Chemetco's process water wells. The point of compliance for the regional aquifer is the property boundary as identified in Figure 3-12. A compliance monitoring program will be conducted for both the upper and lower zones of the regional aquifer. The groundwater monitoring program presented herein was developed to monitor progress toward meeting clean up objectives, to measure the effectiveness of the SID system, and to monitor the GMZ boundaries.

Monitoring wells have been installed in both the upper and the lower zones of the regional aquifer to detect statistically significant differences in water quality potentially resulting from Chemetco operations. The monitoring well locations are shown in Figure 3-l and 3-12.

Background Well

As previously discussed by the IEPA and Chemetco, Chemetco has recently installed a new background wells, 51 and 52, (upgradient with respect to the regional groundwater flow direction) located southeast of the facility, as the upgradient wells for the regional aquifer.

Upper Zone

The compliance monitoring well network was installed to provide upgradient and downgradient indicators of groundwater quality in the upper zone of the regional aquifer. Groundwater in the Regional Aquifer contained elevated levels of arsenic, cadmium, chromium, lead and nickel. As discussed in Section 3.5.1, concentrations have been decreasing. The trend analysis performed in 1993, refer to 1993 Annual Groundwater Report indicated only well 47 had an increasing trend. Well 47 has recently been replaced with 47R. The results from this well were sporadic and difficult to interpret. During the third quarter 1997 sampling event, the new background well, 51, was sampled and analyzed. Concentrations of Cadmium and lead were above the 620 standard. As stated in Section 3.5.2, this will be evaluated further as more data is collected.

In response to IEPA concerns about well spacing, downgradient (under natural flow conditions) monitoring wells were installed at approximately 200-foot intervals along the facility's northwestern and northern fence lines. In response to additional IEPA concerns, wells were installed along the eastern fence line.

The upper zone of the regional aquifer will be monitored, through semi-annual sampling once background has been established, by wells 56, 37R, 38R, 48, 49, 50, 55, 44R, and 47R for constituents specified in Section 3.9.5.5. Groundwater elevations will be taken from these wells plus wells 26R, 32R, and 33 on a semi-annual basis.

Groundwater Management Zone

As indicated in Section 3.9.2, Chemetco believes that the groundwater at the facility meets the criteria specified in Section 620.250(a) for designation as a groundwater management zone (GMZ). A GMZ is defined as "a three dimensional region containing groundwater being managed to mitigate impairment caused by the release of contaminants from a site". Chemetco proposes that the GMZ for the regional aquifer correspond to the point of compliance for the regional aquifer as defined in Figure 3-12. All wells monitoring the point of compliance would be considered to lie within the GMZ until the GMZ expires. Trend analysis on wells monitoring the p.o.c. and gmz will demonstrate the effectiveness of the corrective action program. If trends continue downward, Chemetco will conclude that the SID system is effectively recovering all contaminated groundwater and limiting downward migration of contaminants into the regional aquifer and no further actions will be taken. If upward trends are observed, it may be concluded that hazardous constituents are exiting the GMZ and Chemetco will evaluate the need for further efforts. A trend analysis will be used for this determination.

Lower Zone

Four wells were installed to monitor the lower zone of the regional aquifer. Wells 36R, 39R, 52, and 53 are located approximately at the four corners of the facility. Well 52 has been designated a background well. Although no elevated metals have been detected in the facility water supply wells, located in the lower zone, in response to IEPA requests Chemetco will monitor the four wells screened in the lower zone of the regional aquifer.

The lower zone of the regional aquifer will be monitored through semi-annual sampling, by wells 36R, 39R, 52 and 53 for the constituents specified in Section 3.9.5.5. Groundwater elevations will be taken from these wells and 43 and 46 on a semi-annual basis.

3.9.5.5. Hazardous Waste Constituents

Wells listed above and included in Table 3-6 will be sampled semi-annually for once background has been established for the following constituents:

Lead
Cadmium
Zinc
Arsenic
Chromium
Copper
Tin
pH

Nickel

Specific Conductance

TOC

TOX

TOC and TOX have been added to the analyte list as requested by IEPA in the January 29, 1993 approval letter. Nickel was added to the parameter list in April of 1993.

As proposed by Chemetco in the October 1992 closure plan modification request report and approved by IEPA, wells 28, 31A (perched aquifer), 44R, 47R, and 38R (upper zone of the regional aquifer) will be sampled annually and analyzed for 35 IAC 724, Appendix I metals and semi-volatiles. Samples will be collected during the October (4th quarter) sampling round and reported to IEPA in the January 15 semi-annual report.

3.9.5.6 Groundwater Elevations

Groundwater elevations will be measured semi-annually for the wells discussed above and listed in Table 3-6. Depth to groundwater measurements are made using an electric water level meter with an accuracy of +0.01 ft. Depth to groundwater measurements are subtracted from a known elevation of the measuring point to determine groundwater elevation.

3.9.5.7 Flow Rate Measurements

Chemetco proposes to measure and record flow rates from the SID system on a weekly basis rather than on a daily basis requested by IEPA in the January 29, 1993 approval letter. As stated in Section 3.9.5.2 Chemetco believes this frequency will be adequate to meet the objectives of the corrective action measures (listed in Section 3.9.5.1). Rates will be measured as the total number of gallons pumped per week and reported as weekly and quarterly averages on a gallon per minute (gpm) basis.

3.9.5.8 Description of Monitoring System: 724.197(a) and (c), 724.199(a)(l)

The monitoring system has been described in Section 3-2.

3.9.5.9 Description of Sampling and Analysis Procedures: 724.197(d), 724.199(c)

Sampling and analysis procedures are described in Section 3-2.

3.9.5.10 Monitoring Data and Statistical Analysis Procedures: 724.197(e), (g), and (h)

Statistical analysis procedures are discussed in Section 3.6.4.

3.9.5.11 Reporting Requirements: 724.197(j), 724.198(h), 724.199(h), 724.200(g)

As indicated in Section 3.9.5.2 Chemetco proposes to change the sampling and reporting frequency from the quarterly reporting required under interim status to twice each year to be consistent with requirement under 35 Ill. Adm. Code 724.200(g) to report on the effectiveness of the corrective action measures at least semi-annually. Semi-annual groundwater quality monitoring will be conducted in April and October of each calendar year. Semi-annual assessment reports will be submitted after the 2nd and 4th quarters, on July 15 and January 15 respectively. These reports will present the results of semi-annual groundwater quality sampling and analysis, semi-annual water level monitoring data, and weekly flow rate data collected from the SID system, as well as information on the effectiveness of the corrective action measures as required under 35 Ill. Adm. Code 724.200(g), and progress toward achieving cleanup goals. Maintenance activities will be reported in each semi-annual report as necessary. Other information such as survey data will be reported as necessary. The annual report, required under interim status, will be superseded by the two semi-annual reports. The semi-annual report due July 15 will also include statistical analysis and isoconcentration maps.

Chemetco will maintain records of the analyses performed on the groundwater for the life of the facility. Chemetco will report the monitoring results to IEPA semi-annually each calendar year. If the program results indicate that the groundwater no longer contains the constituents of concern, a detection program will be developed and submitted to IEPA for approval.

SECTION 3 REFERENCES

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4. ZINC OXIDE BUNKER CLOSURE PLAN

4.1 CAMU Designation

To facilitate a rapid and cost effective site remediation, Chemetco will be requesting the USEPA designate the zinc oxide bunker as a Corrective Action Management Unit (CAMU) pursuant to 40 CFR, Part 264.552. Creation of a CAMU will allow Chemetco to consolidate remediation wastes from the remediation of the zinc oxide spill area; non clean fill area; sediment from the bottom of the open portion of the canals and slag fines into the bunker without triggering land disposal restrictions or minimum technology requirements. The Regional Administrator has the authority to make this designation since the zinc oxide bunker has begun the closure process and inclusion of the bunker will enhance the implementation of effective, protective and reliable remedial actions for the facility.

4.2 Former Zinc Oxide Pile

The former zinc oxide pile was decommissioned previously by Chemetco and the zinc oxide bunker created in its place. Refer to Figure 4-1. The former (closed) zinc oxide pile will be closed in its "as is" state and be subject to post closure monitoring using the existing groundwater monitoring well system.

This closure plan summarizes the activities completed to date at the bunker/pile and details the closure to be implemented for the existing zinc oxide bunker.

4.3 Summary of Activities Completed to Date

The contents of the zinc oxide pile were removed and the area excavated at the time of decommissioning. As the area was excavated, soil samples were collected and analyzed for Extraction Procedure ("E.P.") Toxicity for lead and cadmium. If samples tested E.P. Toxic, excavation was continued.

The 150-foot by 200-foot zinc oxide pile was used to store and dry zinc oxide from the zinc oxide lagoons. Containment was provided by a low permeability berm and underlying clay that prevented runoff and infiltration, respectively. Closure of the pile began in early 1984 with removal of the stored material and excavation of the underlying soils. Zinc oxide material was moved from the north end of the storage area to the concreted areas to the west with both a crawler-loader and a rubber-tired front end loader. After all the zinc oxide was removed from the north end, the underlying soil was excavated until visibly clean. All excavated soil was placed with the zinc oxide material on the concrete surface to the west. A sampling grid was laid out at 50- by 75-foot intervals to provide samples for E.P. Toxicity testing for lead and cadmium. Excavation continued until satisfactory results were obtained. After achieving lead and cadmium levels below the detection limits of these analyses, the north section was covered by an 8-inch reinforced concrete slab and containment wall. The process of excavation, sampling, and concrete construction was repeated for the south section of the pile, as described in detail in the 1986 Closure Documentation Report. After the southern slab was poured and cured, the zinc oxide material and the excavated soil were moved by a rubber-tired front-end loader from temporary storage on the concrete west of the old site, to the new storage bunker.

The southern walls were constructed. Also a secondary containment system, consisting of a concrete curb and sump, was constructed around the perimeter of the bunker walls.

4.4. Former Zinc Oxide Pile

The zinc oxide bunker was constructed in 1984 upon decommissioning and confirmatory testing which indicated successful removal of materials from the former zinc oxide pile. The location of the floor of the bunker is such that it completely covers the area where the former pile was placed. The previous sampling and analysis demonstrated the "clean closure" feasibility before the reinforced concrete pad and containment berm were poured. Results of this sampling are presented in Table 4-1 and were submitted as Appendix H in the July 1990 Closure and Post-Closure Plans submitted by Chemetco. These samples were collected beneath the existing bunker at the locations shown on Figure 4-1. Subsequent to this sampling, the Agency established the following cleanup standards for soils at the Chemetco facility:

Lead	0.05 mg/l (EP Toxicity)
Cadmium	0.01 mg/l (EP Toxicity)

The analyses performed on the samples collected from beneath the bunker had a detection limit of 0.05 mg/l for both lead and cadmium. Thus the detection limit is equal to the cleanup standard established for lead, but above the cadmium value.

In negotiations with Chemetco, the Agency has accepted the previous analytical data for lead and confirmed that the unit is considered "clean" as far as lead contamination is concerned. In lieu of verifying that lead and cadmium levels around the bunker and former waste pile units are not above the cleanup objectives, Chemetco proposes to monitor the former waste pile (under post-closure) utilizing the existing groundwater monitoring wells in accordance with 35 Ill. Adm. Code, Part 724, Subpart F.

4.5 Waste Inventory

The zinc oxide bunker presently contains approximately 40,000 tons of zinc oxide and soils excavated from the former zinc oxide pile, the zinc oxide lagoons and the cooling water canal during closure and 23,500 tons of slag. No zinc oxide produced in daily plant operations is presently stored in the bunker. No zinc oxide or other materials have been added to the bunker since the cooling water canal was closed in September 1985. Zinc oxide produced in Chemetco's current operations is a product and is containerized and shipped off-site in accordance with applicable regulations.

4.6 Closure Procedure

Chemetco proposes to close this unit in accordance with landfill standards by capping in-place waste materials.

The area of the bunker will be capped at the time of closure using a modified composite soil/geomembrane cover system. The steps required for construction of the landfill cap and the components of this cover are described below:

- The surface to the north or east of the existing bunker will be prepared for acceptance of some of the zinc oxide and slag presently in the bunker. This area will include a portion of one of the legs of the canal;

- Mechanical equipment will be utilized to move a portion of the present bunker contents and level the top surface of the remaining contents prior to construction of the impermeable cap;

- A 12-inch leveling course of fine slag over the material in the bunker to act as a buffer between the material and the geomembrane;

- National Seal Company's GCL Bentofix NS or equivalent which combines a durable geotextile to a low permeability sodium bentonite;

- A 30-mil thick geomembrane to limit infiltration while accommodating settling and subsidence;

- National Seal Company's or equivalent TEX-NET TN3002/112SCN consisting of a geocomposite drainage system with a heat bonded geotextile placed on the top.

- An 18-inch thick fill layer to provide soil moisture retention and to buffer the underlying layers from root and rodent penetration;

- A 6-inch thick soil layer to support hardy shallow-root vegetation and

- Seed and mulch to establish vegetation.

The cover system will be installed on the area shown in Figure 4-2. Material specifications and placement procedures are provided as Appendix 4-1. The quality assurance testing program to be implemented during construction of the cover is provided as Appendix 4-2. The area will be graded to establish top slopes of between 3 and 5 percent, which will promote runoff and prevent ponding. The vegetative cover will consist of a grass with a shallow root system which will act to minimize soil erosion. The existing fence surrounding the facility will prevent unauthorized access and disturbance of the cover system.

Chemetco will prepare detailed engineering specifications and drawings for this cover system after receiving approval of a CAMU designation from the Regional Administrator. The detailed specifications will be based on a survey to establish the limits of the bunker expansion. Surveying will be performed with respect to permanent benchmarks by a professional land surveyor. Specifications and drawings will be sealed and signed by a professional engineer registered in the State of Illinois. The detailed specifications will be submitted for IEPA approval, as a revision to the zinc oxide bunker closure plan.

4.7 Post-Closure Care

Post-closure care will begin after completion of the closure certification and will continue for thirty (30) years, unless the care period is shortened or extended by IEPA. Post-closure care will consist of groundwater monitoring as described in Section 3.

The facility contact during the post-closure care period is:

Environmental Manager
Chemetco, Inc.
P.O. Box 67
Hartford, Illinois 62048
(618) 254-4381

4.8 Certifications and Notices

During the closure activity and post-closure care, an independent, registered professional engineer will conduct periodic inspections to ensure that all critical activities are completed adequately and in accordance with the approved Closure (or Contingent Closure) and Post-Closure Plans.

Within sixty (60) days of completion of closure, Chemetco will submit by registered mail to the Administrator of USEPA Region V and the Director of the IEPA certification by Chemetco and an independent professional engineer registered in the State of Illinois that the facility has been closed in accordance with the approved closure plan. Likewise, within sixty (60) days of completion of post-closure care, certification will be submitted that the approved post-closure plan was followed. The certification will be signed by a responsible corporate officer, or duly authorized representative, and will contain the certification statement required under 35 Ill. Adm. Code Subtitle G, Section 702.126.

Chemetco will submit a survey plat at the time of closure certification to both IEPA and the local zoning authority if the Contingent Closure Plan is implemented. The plat will indicate the location of the bunker with respect to permanently surveyed benchmarks, will note that the area's future use is restricted, and will be prepared and certified by a professional land surveyor. Within sixty (60) days of closure certification, Chemetco will submit a record of types, amounts, and location of waste materials or residuals in the bunker to both IEPA and the local zoning authority. Within sixty (60) days of closure certification, Chemetco will also record a notation on the property deed and submit certification that such a notation has been made in accordance with 35 Ill. Adm. Code 724, Subpart G. This notation will alert any potential purchaser of the property that the land has been used to manage hazardous waste and its future use is restricted to a shallow-rooted grassland or non-residential or commercial development (i.e., parking area).

Within sixty (60) days of completion of the post-closure care period, Chemetco will submit to the Agency, by registered mail, a certification, signed by a responsible corporate officer, or duly authorized representative, and an independent registered professional engineer, that the activities during the post-closure care period were performed in accordance with the specifications in the approved post-closure plan.

4.9 Closure Schedule

Chemetco proposes to close the existing zinc oxide bunker in accordance with the schedule outlined in Figure 4-3. Should events beyond the control of Chemetco occur, an amendment to the closure schedule(s) will be submitted for Agency approval.

Within 60 days of IEPA approval of the proposed closure plan specific to the former zinc oxide piles, closure certification by an independent Illinois registered professional engineer and Chemetco will be submitted to the Administrator of USEPA, Region V and the Director of the IEPA. Post-closure of this unit will not commence until final plant shut-down.

TABLE 4-1

SUMMARY EP TOXICITY TEST RESULTS

FORMER ZINC OXIDE PILE

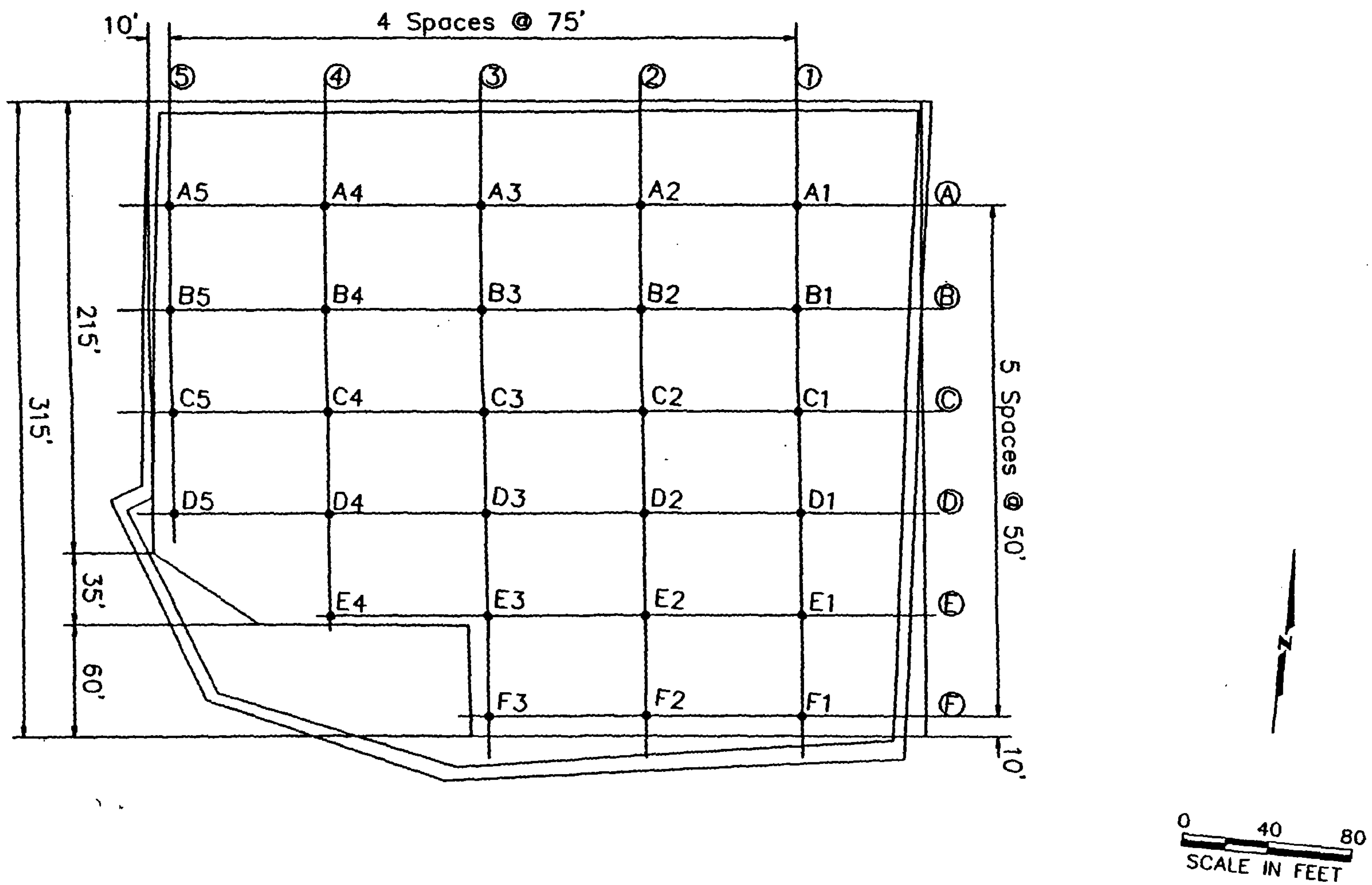
Sample No.	Lead mg/l	Cadmium mg/l	Lab
A1	BDL	BDL	ERT
A2	BDL	BDL	ERT
A3	BDL	BDL	ERT
A4	BDL	BDL	ERT
A5	BDL	BDL	ERT
B1	BDL	BDL	ERT
B2	BDL	BDL	ERT
B3	BDL	BDL	ERT
B4	BDL	BDL	ERT
B5	BDL	BDL	ERT
C1	BDL	BDL	ERT
C2	BDL	BDL	ERT
C3	BDL	BDL	ERT
C4	BDL	BDL	ERT
C5	BDL	BDL	ERT
D1	BDL	BDL	ERT
D2	BDL	BDL	ERT
D3	BDL	BDL	ERT
D4	BDL	BDL	ERT
D5	BDL	BDL	ERT
E1	BDL	BDL	ERT
E2	BDL	BDL	ERT
E3	BDL	BDL	ERT
E4	BDL	BDL	ERT
F1	BDL	BDL	ERT
F2	BDL	BDL	ERT
F3	BDL	BDL	ERT

Detection Limit: 0.05mg/l.

Analytical Method: SW 846 Method 6010

7008H 1100-001-100-100R

110011A



LEGEND

• Former Soil Sample

ENSR

ENSR CONSULTING & ENGINEERING

FIGURE 4-1
ZINC OXIDE BUNKER
FORMER SAMPLING GRID

DRAWN BY: | DATE:

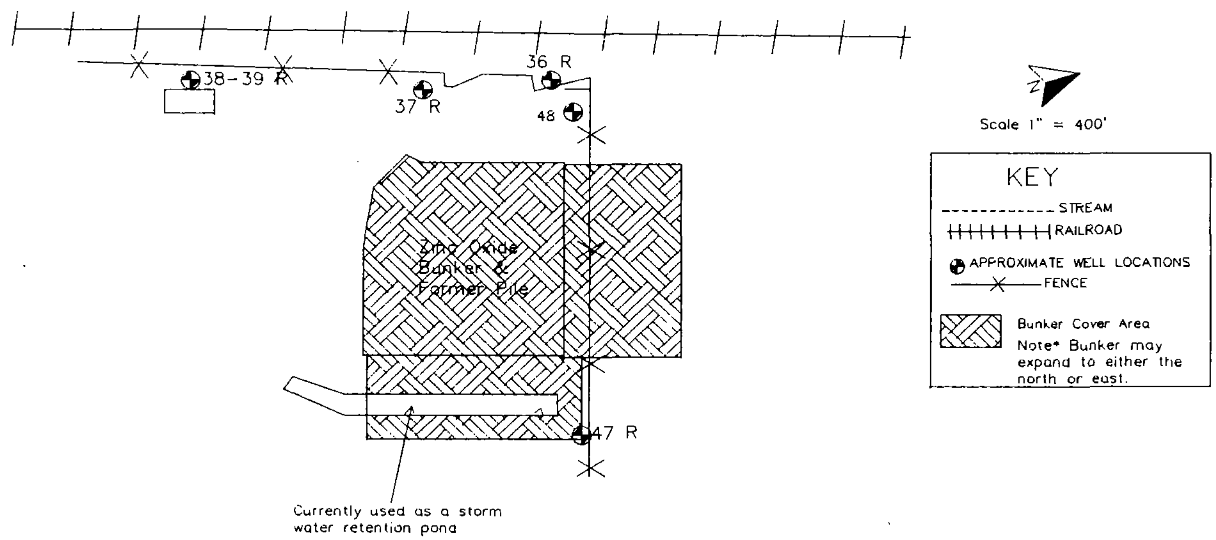


FIGURE 4-2
Zinc Oxide Bunker Cover
Chemetco, Inc.

CSD Environmental Services, Inc.

Chemetco Inc.
Figure 4-3
Closure Schedule for the Zinc Oxide Bunker

Activity	**Time**											
Begins upon receipt of final volume of waste	0-30days	30-60	60-90	90-120	120-150	150-180	180-210	210-240	240-270	270-300	300-330	330-360
Survey Limits												
Place and compact soil layer												
Place Bentofix or equivalent												
Place and seam 30mil or greater liner												
Place and seam TEX NET or equivalent												
Place 18" thick fill												
Place 6" soil												
hydroseed and mulch												
PE certification												
Closure Certification Report												

APPENDIX 4-1

A. SURVEY CONTROL

A.1 Scope

The work included in this section shall consist of furnishing all labor and equipment to establish on-site survey control and grade stakes to establish limits of work for final covering and final grade elevations in conformance with the plans and specifications.

A.2 Survey Control

The Contractor shall provide all on-site horizontal and vertical survey control for the establishment of baseline(s) and limits and grades for the fill area as shown on the drawings.

The baselines shall be staked and labelled at one hundred (100) foot stations. The Contractor shall provide additional survey control as necessary for witness stakes, offset stakes, and line and grade stakes to establish the required control over the filling and to re-establish such control as may be removed or disturbed by construction.

B. BACKFILL

B.1 Scope

The work under this section includes the furnishing of all labor, equipment, materials and the performing of all operations in connection with furnishing, placing, grading and compacting backfill to the limits shown on the drawings.

B.2 Materials

Material for backfill shall be a natural soil composed of clay, sand, silt and/or gravelly sand and shall be from off-site sources. Backfill texture shall conform to one or more of the following soil groups as defined by the Unified Soil Classification System:

Symbol	Description
SW	well graded sands, gravelly sands, little or no fines
SM	silty sands, sand-silt mixtures
SP	poorly graded sands or gravelly sands, little or no fines
SC	clayey sands, sand-clay mixtures
CL	inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
CH	inorganic clays of high plasticity, fat clays

Prior to backfill placement, one representative sample from each source shall be submitted to an independent soil testing laboratory for the determination of optimum moisture content and maximum density according to ASTM Method D-698 Standard Proctor Test. The contractor shall be responsible for identifying the sources and shall obtain representative samples and submit the samples to an Owner-approved laboratory. The contractor shall provide the test results to the Owner. Testing and acceptance shall conform to the procedures described in Appendix I-2, "Construction Quality Assurance and Quality Control Plan".

B.3 Placement and Compaction

Backfill shall be placed within the fill limits shown on the drawings. Backfill shall be placed in layers and compacted according to the type of soil used as fill. For soil types SW, SM and SP, a track-type tractor or rubber tired roller shall be utilized. SW, SM and SP type backfill shall be placed in lifts so that the compacted layer is not thicker than 12 inches. Track type tractors shall weigh at least 30,000 lbs*. Rubber tired rollers shall have a wheel load in excess of 15,000* lbs. Each layer shall be compacted by not less than six passes of the equipment. A complete pass shall consist of the entire coverage of the layer with one trip of the equipment. Each trip shall over lap the adjacent trip by not less than two (2) feet.

For soil types SC, CL and CH, a rubber tired roller or tamping (sheepsfoot) roller will be used. If the rubber tired roller is selected, the compaction equipment requirement shall be the same as described in the above paragraph for soil types SW, SM and SP. If a sheepsfoot roller is selected, the layer thickness shall not be thicker than six (6) inches after compaction. The length of the foot on the sheepsfoot roller shall not be less than seven and one-half (7 1/2) inches. The *Corps of Engineers, Bureau of Land Reclamation recommendations in Soils Manual (The Asphalt Institute) loaded weight of the sheepsfoot roller shall not be less than 30,000 lbs*. Each layer compacted by the sheepsfoot roller shall be compacted by not less than six (6) passes. A complete pass shall consist of the entire coverage of the layer with one trip of the sheepsfoot roller. Each trip shall overlap the adjacent trip by not less than two (2) feet. The moisture content of the backfill shall be three (3) to five (5) percent above the optimum moisture content as determined by the Standard Proctor Test (ASTM D-698).

Each lift shall be compacted to at least 90% of maximum dry density as determined by the Owner's Inspector, as described in Appendix I-2, "Construction Quality Assurance and Quality Control Plan".

B.4 Grading

Backfill shall be placed in compacted lifts until a point has been reached that is 2 feet 6 inches below the final grade, as shown on the drawings. The completed backfill surface shall be rough graded and uniform.

*EPA Seminar - Requirements for Hazardous Waste Landfill Design, Construction & Closure (Presentations, 1988).

C. CLAY COVER

C.1 Scope

The work under this section includes the furnishing of all labor, equipment, materials, and the performing of all operations in connection with furnishing, placing, grading, and compacting a clay cover over the backfill.

C.2 Materials

Cover material shall be a natural soil composed of clay and silt. It shall be free of boulders, brush, stumps, waste or debris, and similar materials. Cover material shall be uncontaminated and will be obtained from an off-site source. The responsibility for Quality Assurance shall be placed upon the contractor providing cover material. In delivering cover material the contractor shall provide to the Owner the source location and assurance that materials have not been removed from a previous industrialized location where contamination of the material is likely to have occurred.

Quality Control will be the responsibility of the Owner. QC measures will include confirmation of the source location and random visual inspections of the material as it is being delivered to the site to confirm the absence of any obvious unnatural staining and other foreign materials (e.g., broken bricks, concrete, rubber) which might indicate an unacceptable source or previous industrial application.

Cover material texture shall conform to one or more of the following soil groups as defined by the Unified Soil Classification System:

Symbol	Description
CL	inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
CH	inorganic clays of high plasticity, fat clays

Prior to cover placement one representative sample of cover material from each source shall be submitted to an independent soil testing laboratory for the determination of moisture content, grain size distribution, specific gravity, liquid and plastic limits, moisture-density relationship, and hydraulic conductivities at various densities and moisture contents. A sufficient number of tests will be accomplished upon representative samples of the cohesive clay or silt (CL, or CH) proposed to be furnished for use in the clay cover to determine the most practical combination of densities and moisture contents to assure an in-place coefficient of permeability of not more than 1 x 10^{-7} cm/sec. At least one lab permeability test series shall be performed for every 10,000 cubic yards of soil to be used as the clay cover. The Contractor shall be responsible for identifying the sources, and shall obtain and submit the samples to an Owner-approved laboratory. The Contractor shall be responsible for identifying the sources, and shall obtain and submit the samples to an Owner-approved laboratory. The Contractor shall provide test results to the Owner. Testing and acceptance shall conform to the procedures described in Appendix I-4, "Construction Quality Assurance and Quality Control Plan".

C.3 Placement and Compaction

The cover shall be placed and spread in layers so that the total compacted thickness of the clay is not less than 18 inches. Each individual layer will not exceed six (6) inches. The cover shall be compacted by a sheepsfoot roller with feet 3ot less than seven and one half (7 1/2) inches in length. The loaded weight of the sheepsfoot roller shall not be less than 30,000 lbs. Each layer shall be compacted by not less than six (6) passes. A complete pass shall consist of the entire coverage of the layer with one trip of the roller. Each trip shall overlap the adjacent trip by not less than two (2) feet.

Each lift shall be placed to achieve a moisture content and dry density that is within the acceptable range for the required hydraulic conductivity. The acceptable range will be determined by material testing as described in C.2 above. The field density of the compacted final cover shall be field tested by the Owner's Inspector as described in Appendix I-4.

C.4 Grading

Cover material shall be placed in compacted lifts until a point has been reached that is 12 inches below the final grade, as shown on the drawings. The completed cover surface shall be rough graded and uniform.

C.5 Soil Testing

Soil testing shall be performed in accordance with Technical Specification F entitled "Soils Testing".

D. TOPSOILING

D.1 Scope

The work under this section includes the furnishing of all labor, equipment, materials, and the performing of all operations in connection with furnishing, placing, and grading topsoil over the compacted final cover surface.

D.2 Materials

Material for topsoil shall be natural surface soil, friable and loamy, free of debris, stumps, brush, litter, and stones larger than three (3) inches in diameter. The topsoil shall not contain toxic substances that may be harmful to plant growth. A pH range of 5.0 to 7.5 is acceptable. Topsoil shall have a minimum organic content of 2.75%. Prior to topsoil placement, the contractor shall test one representative sample of each source of material for acidity and organic content, as described in Appendix I-2, "Construction Quality Assurance and Quality Control Plan".

D.3 Placement and Grading

Topsoil shall be placed over the compacted final cover soils within the limits shown on the drawings and shall be evenly and smoothly spread over the surface. Topsoil shall be placed so that the total thickness is not less than twelve (12) inches after firming. Topsoil shall not be placed while in a frozen or muddy condition or when the final cover is excessively wet and soft or in a condition that may otherwise be detrimental to proper grading.

E. SEEDING AND EROSION CONTROL

E.1 Scope

The work included in this section includes the furnishing of all labor, equipment and materials, and in performing all operations in connection with the application of lime or sulfur, seeding, fertilizing, and mulching, of the area indicated on the drawings, completed and accepted, in accordance with the specifications and drawings.

E.2 Materials

E.2.1 Lime

Lime shall be agricultural ground dolomitic limestone conforming to the standards of the Association of Official Agricultural Chemists, and complying with all existing State and Federal Regulations. The materials must comply with the following gradation:

Square Mesh Sieves	% Passing by Weight
Pass #10	100
Pass #20	90
Pass #200	50

The minimum calcium carbonate equivalent shall be 90% by weight. The Owner reserves the right to draw such samples and to perform such tests as the Owner deems necessary to assure that these specifications are met.

E.2.2 Sulfur

Sulfur shall be commercial flour sulfur, unadulterated, and shall be delivered to the site in the original unopened containers or in bulk lots with the name of the manufacturer, material analysis and net weight specified.

E.2.3 Fertilizer

Fertilizer shall be a complete fertilizer containing 10% nitrogen, 20% potash, and 10% phosphorous and referred to as 10-20-10. The total nitrogen content shall either be derived from natural organic sources or be a urea-form fertilizer. The commercial fertilizer shall be delivered to the site in the original unopened containers which shall bear the guaranteed statement of analysis of the manufacturer.

E.2.4 Seed Mixture

The seed mixture shall be delivered to the site in new, clean, sealed containers. Labels and contents shall conform to all State and Federal regulations. Seed shall be subject to the testing procedures of the Association of Official Seed Analysts. The seed shall be delivered to the site accompanied by a properly executed certificate from the supplier of each type of seed attesting to its freshness, components, proportion (if mixed), minimum purity, and minimum germination. The seed quality and certificates are subject to approval by the Owner prior to their being applied. Acceptable seed types and application rates include:

Seed Name	Application Rate
Bermuda Grass (cynodon dactylon)	7 lbs/acre
Annual Ryegrass (lolium multiflorum)	20 lbs/acre

E.2.5 Straw

Straw shall be small-grain straw or hay. As necessary, a liquid mulch binder such as emulsified asphalt, cutback asphalt, or synthetic or organic binders shall be used at the rates recommended by the manufacturer.

E.2.6 Water

Water used in this work will be furnished by the Owner and will be suitable for irrigation and free from oil, acid, alkali, salt and other substances harmful to plant life. The Contractor will provide all equipment including hose necessary to apply the irrigation water.

E.3 Season of Seeding

The preferred dates for seeding are May 1 to July 1. If these dates are missed, then alternate dates are August 1 to November 15.

E.4 Application

E.4.1 Application of Lime or Sulfur

Lime or sulfer shall be applied at rates determined by the Owner based on tests of the topsoil material, as described at D.2. When applied dry, the limestone or sulfur shall be spread evenly and then thoroughly incorporated into the top three (3) inches of the soil by approved means and shall produce a roughened seedbed. When applied hydraulically, no discing will be necessary.

E.4.2 Application of Fertilizer and Seed

The preferred method of applying fertilizer and seed shall be hydraulic, however, any agronomically acceptable and reasonable method of uniformly applying the seed and/or the fertilizer separately or together may be utilized that is approved by the Owner. The Owner shall reserve the right to temporarily halt any seeding operation during the presence of strong winds. Fertilizer shall be applied at the rate of 500 lbs per acre. Seed shall be applied at the rates recommended by the Supplier(s), subject to Owner-approval.

E.4.3 Application of Mulch

The straw mulch shall be applied hydraulically or by hand, at the rate of 2-2.5 tons per acre. As necessary, straw mulch shall be coated with a liquid mulch binder in accordance with the manufacturer's recommendations. Mulching shall be performed as a separate operation.

E.5 Maintenance

E.5.1 The Contractor

The Contractor shall be required to replant, using full amounts of all specified materials and all of the complimentary procedures, those areas damaged by wind, fire, erosion, equipment, or pedestrian traffic during the life of the contract, to the satisfaction of the Owner.

E.5.2 The Contractor

The Contractor shall be required to clean up and remove all debris resulting from the seeding operations on roads and other areas within and adjacent to the project.

F. SOIL TESTING

F.1 Scope

Furnish labor, materials and equipment necessary for the sampling, testing and reporting of soils materials from both on-site sources and approved off-site borrow sources proposed to be used for the Cover.

F.2 General

A. Following are major items of work included:

B. Collection of a sufficient quantity of soil samples representative of the on-site and borrow materials to be used for the Cover;

C. Transporting and preparation of the soil samples for the required testing,f whether in the field or in an approved commercial testing facility;

D. Testing the soil samples in accordance with all appropriate ASTM procedures, modified as may be specified in this Section and conforming to the testing schedule as detailed hereinafter;

E. Orally reporting the results directly to the Engineer in the field, and by follow-up written report within two (2) working days after completion of each test.

F.3 Testing Procedures

A. The contractor shall arrange for an approved commercial testing agency to sample, test and report the pertinent engineering characteristics of representative samples of all borrow materials proposed to be furnished for use on this project from any off-site sources at least two (2) weeks prior to the start of its intended use. The Engineer reserves the right to reject any material, source, or portion of a source which in his opinion will not provide the intended and specified function or end use of said material. In case of rejection, the Contractor shall propose an additional material or source from which he shall obtain the quantity of material required for project use.

F.4 Testing Schedule

A. Prior to the acceptance of any materials from any on-site or off-site source for any purpose, the Contractor shall arrange for a sufficient number of tests deemed acceptable by the Engineer to be accomplished in the testing laboratory to establish the following engineering characteristics of granular and cohesive materials:

1) Particle Size Analysis of Soils - ASTM D 1556

2) Amount of Materials in Soils finer than No. 200 Sieve - ASTM D 1140

3) Liquid Limit of Soils - ASTM D 423

4) Plastic Limit and Plasticity Index of Soils - ASTM D 424

5) Moisture Content of Soil - ASTM D 2216

6) Moisture - Density Relations of Soils - ASTM D 698

7) Permeability Test for Clay Liner in Cap System - Illinois EPA Method

   Laboratory determination of permeability of fine grained soils shall be performed using the modified triaxial apparatus technique, including backpressure saturation, to determine the constant head, saturated permeability of "undisturbed" soil samples. Disturbance of the soil sample shall be minimized both before and durifng the determination in order to approximate actual field conditions. The permeant liquid shall be either tap water or a 0.005 N $CaSO_4$ solution. In any case, distilled water shall not be used. The effective stress (confining cell pressure minus the average of the headwater and tailwater pressures) applied to the soil sample in the triaxial apparatus shall be set as close as possible to the expected in situ-stress conditions to prevent excessive consolidation of the soil sample.

   Laboratory permeability determination reports shall include a detailed description of both the sample collection and preparation techniques and the details (cell pressure, headwater pressure, tailwater pressure, driving pressure, gradient, sample size, permeant liquid, time, etc.) of the determination procedures. Tests shall be performed in two phases as specified below.

Phase I: Collect and prepare a sample and backpressure saturate. Subject the sample to a constant hydraulic gradient (driving force pressure expressed in centimeters of water divided by length of sample in centimeters) of less than 20 until the volume of permeant flowing out of the sample in a minimum period of three (3) hours is equal to the volume input in the same period. Compute the permeability at the conclusion of the steady state period.

Phase II: Prepare an identical sample and backpressure saturate. Subject the sample to a constant hydraulic gradient not exceeding 300. This gradient shall be maintained until at least two (2) pore volumes of permeant liquid have passed through this soil sample. Readings shall be taken and permeability computed at the lesser interval of 0.25 pore-volume or 24-hours. The results shall be plotted on an arithmetic scale to show permeability versus pore volume. If the measured permeability is relatively constant or decreases with the number of pore volumes passed through the sample, then it can be concluded that the permeant does not alter the soil skeleton so as to increase the specimen permeability from the Phase I test. However, should the measured permeability show an increasing trend, the procedure required for liners must be performed on that soil type to determine the sample's permeability.

B. A sufficient number of tests shall be accomplished upon samples of the cohesive clay or silt (CL or CH) proposed to be furnished for use in the cap to determine the most practical combination of densities and moisture contents to assure an in-place coefficient of permeability of not more than 1×10^{-7} cm/sec.

C. After materials from either on-site or off-site sources have been approved for use in the Cap on the project, a sufficient number of representative samples of the materials being placed shall be tested to insure that their properties are consistent with those established when approving these materials. The minimum numbers of both tests on Silt and Clay provided as the clay layer in the Cap materials are as follows:

1) At least one test per 1,000 cubic yards being placed:

a) Particle Size of Analysis of Soils

b) Materials finer than No. 200 Sieve

2) At least one test per 250 cubic yards being placed:

   a) Density (including Moisture Content) of soil in place by one of the following materials:

      Rubber-Balloon Method - A55M D 2167
      Sand-Cover Method - ASTM D1556
      Nuclear Method - D 2922/D 3217

3) At least one test per 5,000 yards being placed:

   a) Liquid Limit of Soils

   b) Plastic Limit and Plasticity Index of Soils

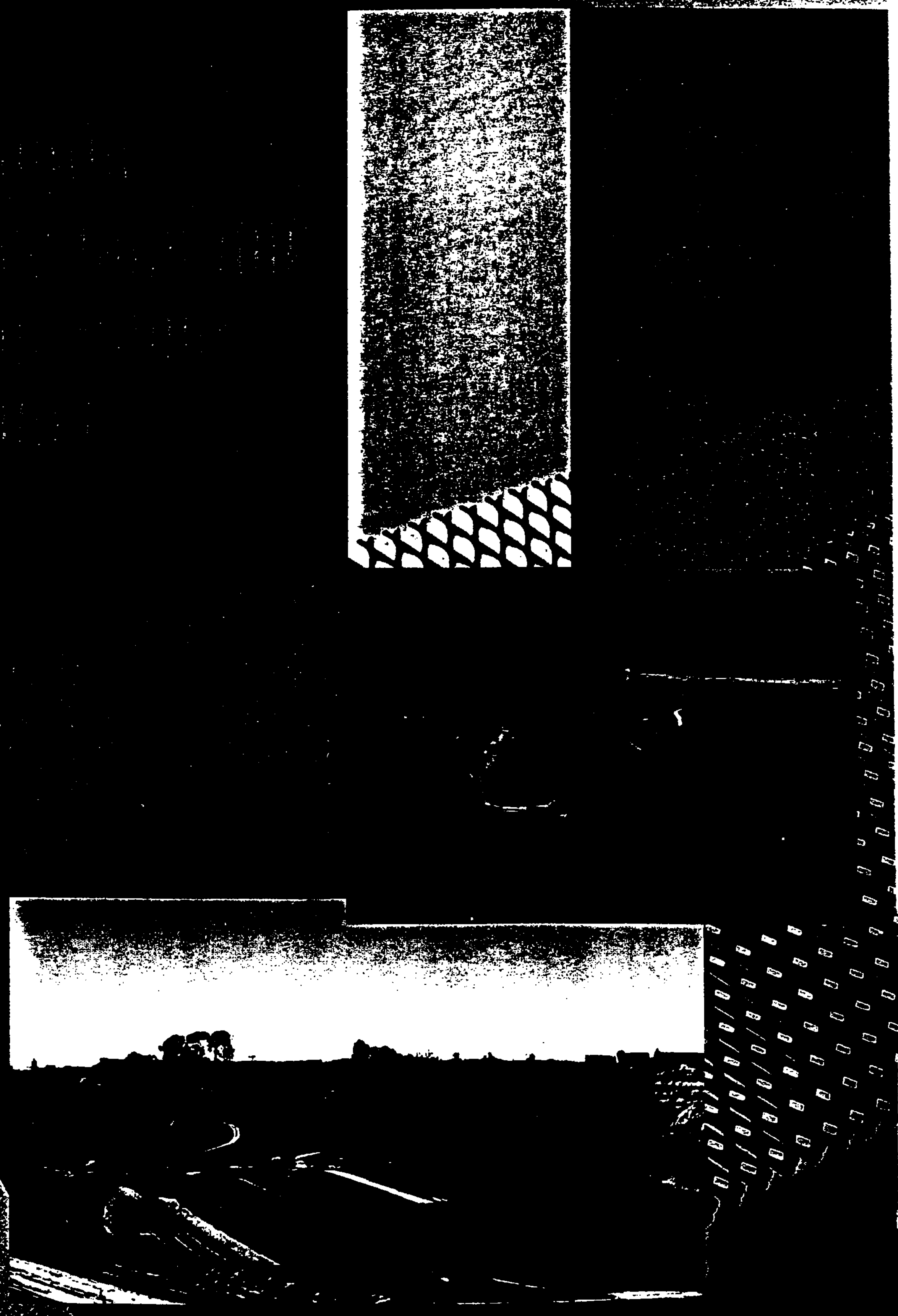
Justification for the sampling frequences is provided in the attached Table 1.

TABLE 1

Testing Frequencies

Recommendations for Construction Documentation of Clay-Lined Landfills by the Wisconsin Department of Natural Resources

Item	Testing	Frequency
1. Clay borrow source testing	Grain size	1,000 yd^3
	Moisture content	1,000 yd^3
	Atterberg limits (liquid limit and plasticity index)	5,000 yd^3
	Moisture-density curve	5,000 yd^3 and all changes in material
	Lab permeability (remolded samples)	10,000 yd^3
2 Clay liner testing during construction	Density (nuclear or sand cone)	5 tests/acre/lift (250 yd^3)
	Moisture content	5 tests/acre/lift (250 yd^3)
	Undisturbed permeability	1 test/acre/lift (1,500 yd^3)
	Dry density (undisturbed sample)	1 test/acre/lift (1,500 yd^3)
	Moisture content (undisturbed sample)	1 test/acre/lift (1,500 yd^3)
	Atterberg limits (liquid limit and plasticity index)	1 test/acre/lift (1,500 yd^3)
	Grain size (to the 2-micron particle size)	1 test/acre/lift (1,500 yd^3)
	Moisture-density curve (as per clay borrow requirements)	5,000 yd^3 and all changes in material
3. Granular drainage blanket testing	Grain size (to the No. 200 sieve)	1,500 yd^3
	Permeability	3,000 yd^3
Source: Gordon et al., 1984.		



National Seal Company

...Solves Your Specific Containment Problems

Precision Manufacturing Methods

Because a high-quality containment system must begin with the highest-quality liner, at National Seal Company we manufacture our geomembranes using the most precise method available in the industry today — flat sheet extrusion.

With the largest flat sheet extruder in the world, we produce geomembranes up to 30.5 feet (9.3 meters) wide. This width allows fewer seams and more efficient installation, which ultimately lowers construction and quality assurance costs.

We continuously monitor thickness across the width of each geomembrane roll, using a nuclear gauging device. Final results are confirmed in laboratory testing. So the thickness of the sheet at any given test point will typically vary no more than 3% from the target thickness.

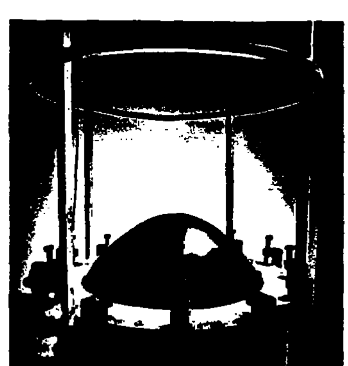
Quality Control

At our in-house Technical Center, we conduct various quality control tests, as well as other sophisticated research and development tests such as multi-axial tensile, high-pressure OIT and point stress tests.

We also perform EPA Method 9090 testing, which measures the chemical compatibility of geosynthetics with site-specific leachates. In addition to Method 9090, our technicians continually test the effects of a variety of solvents on all geosynthetics. We also use accelerated ultraviolet exposure to test long-term stability to ultraviolet radiation.

In our Construction Quality Control (CQC) Laboratory, a division of R & D, the CQC lab team develops new welding equipment, investigates improved methods of seaming, and provides welding training.

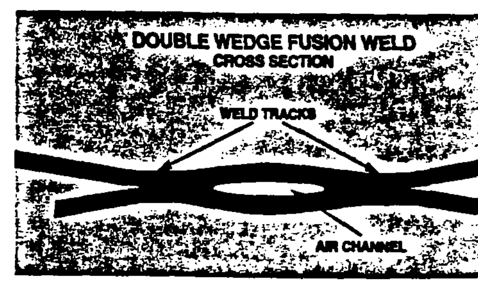
Using the latest equipment, the CQC lab also provides technical support for our field installation teams, who follow strict seaming procedures. In fact, on all National Seal installations, a trained CQC technician is devoted solely to construction quality control.



Careful, Thorough, Rigorous Installation

No matter how high-quality a liner we provide, a poor installation job could undermine the project. That's why we have led the industry in developing innovative installation techniques.

National Seal pioneered the double-wedge fusion welding technique — now the standard in the industry. Our fusion welding machine is an automated, self-propelled device which controls weld temperature, weld pressure and welding speed.



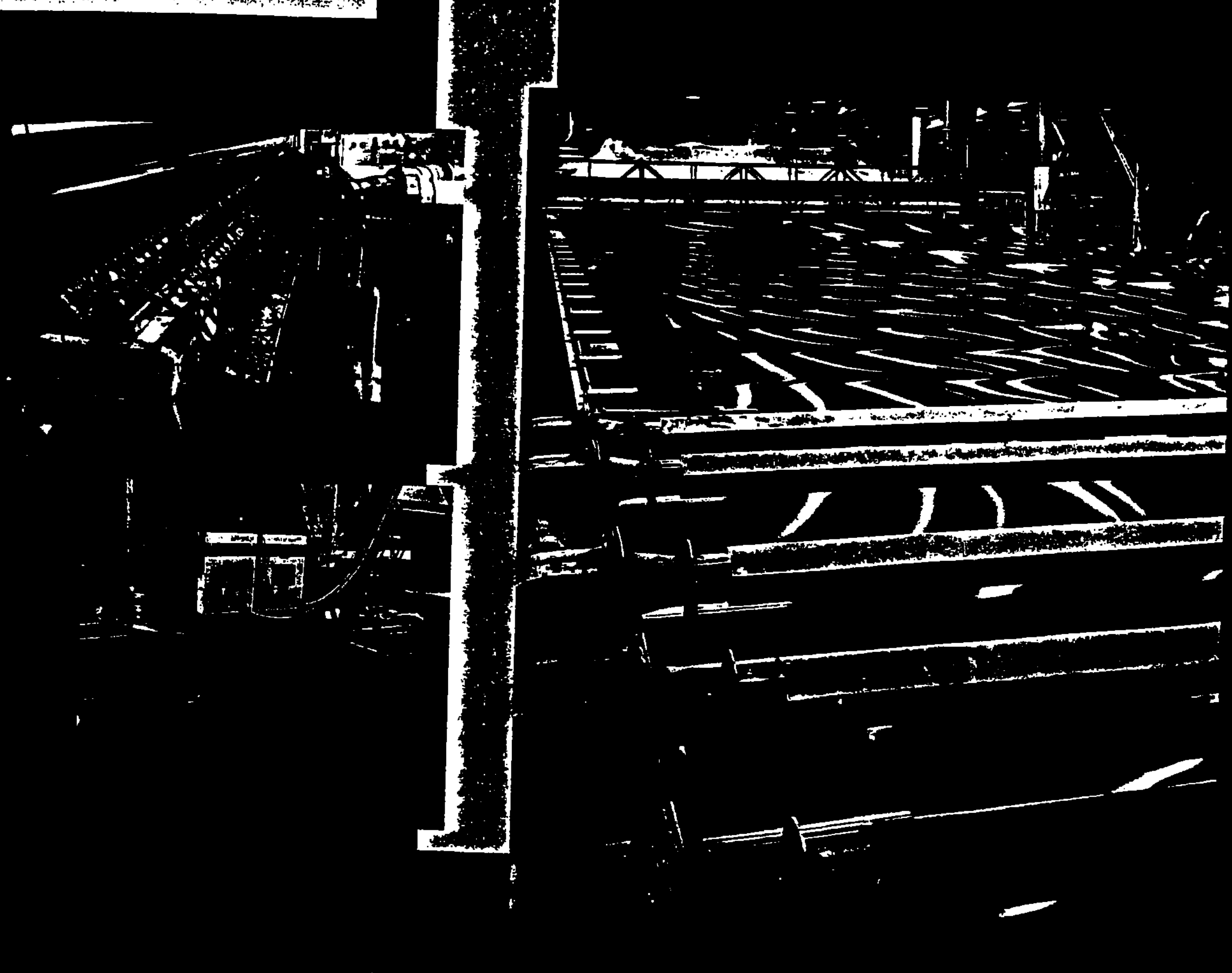
This seaming method creates a superior weld geometry — two welded areas separated by an unwelded channel. When that channel is pressurized with air, our field technicians monitor the pressure: if the pressure falls, it indicates a flaw in the seam. In this way, we can test the entire seam — thoroughly — at one time. A typical 500 foot (150 meter) seam can be tested in 15 minutes, as opposed to the time-consuming vacuum box method.

National Seal Company

Everyone's containment problems are different. Solid waste. Hazardous waste. Liquid containment. Secondary containment for chemical storage tanks.

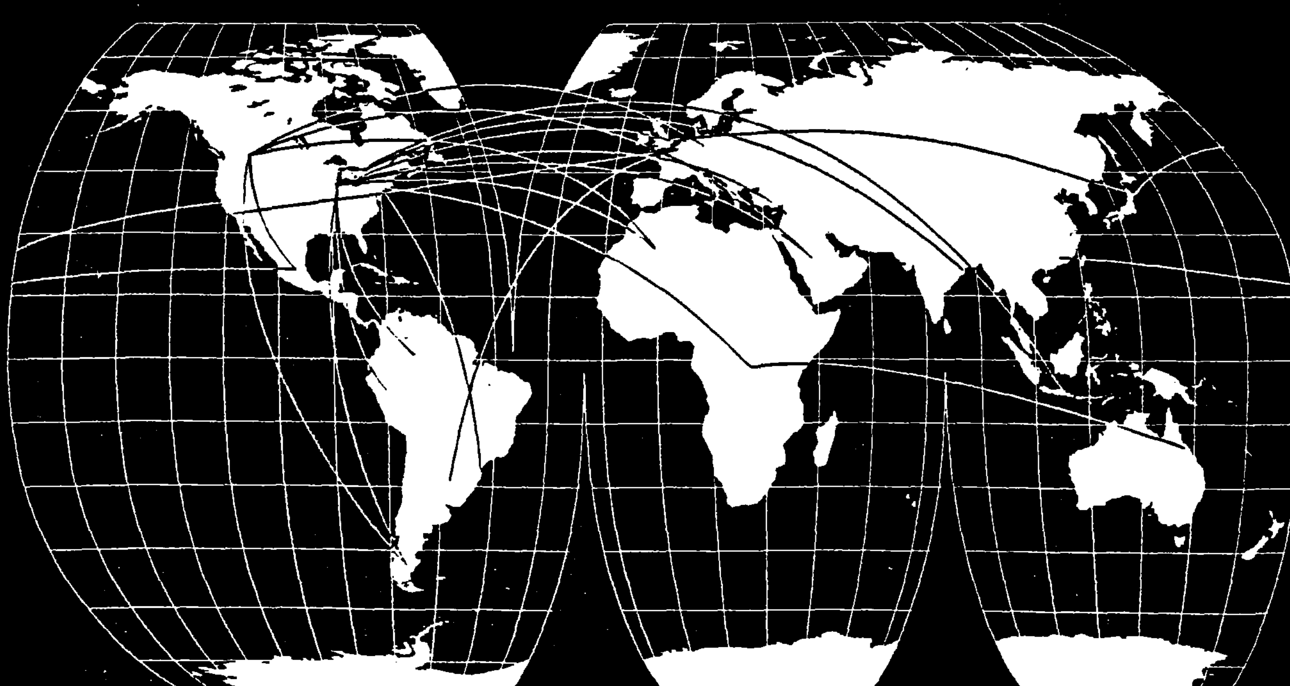
That's why National Seal Company, founded in 1979, has made a strong commitment to research and innovation, so we can provide you with precisely the geosynthetic you need. And because the highest-quality containment system is only as good as its installation, we've established an industry-leading construction division with expertise across a broad range of applications.

At National Seal Company, our commitment goes beyond providing you with geosynthetics — we also provide the most effective and economical solution to your containment problem.



Worldwide Distribution Network

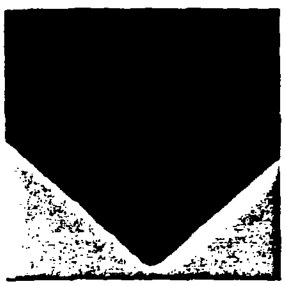
For our domestic and international markets, National Seal Company has developed a strong distributor network with a complete knowledge of our products and installation techniques. National Seal's high-quality products are stored at strategically located areas to assure you of fast delivery for timely completion of projects. We continuously coordinate with engineers, consultants, distributors and other suppliers to ensure that your project receives the highest degree of attention concerning both products and installation — throughout the world.



In a Typical Landfill Installation, Here is How Many of These Products W

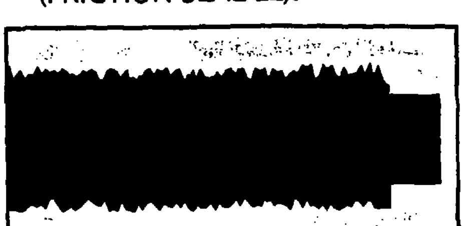
Geomembrane Liners

National Seal Company has concentrated on polyethylene liners, the choice of environmental engineers, since 1982. We manufacture DURA SEAL HD, FRICTION SEAL and DURA SEAL LL geomembrane liners.

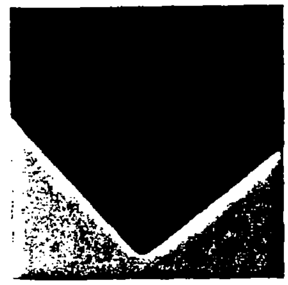


FRICTION SEAL textured high-performance geomembrane liners allow you to increase friction angles between layers. In a landfill, that means you can increase airspace by steepening slopes. FRICTION SEAL also allows steeper slope design in landfill caps and sludge caps.

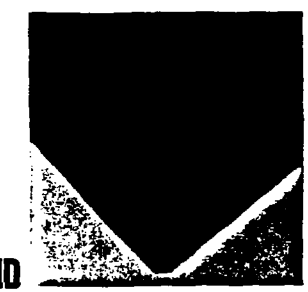
In addition to coextrusion friction manufacturing capabilities for FRICTION SEAL, we have developed a special secondary manufacturing process which does not compromise liner thickness tolerances or base sheet properties. This process attaches a high-performance textured surface to one or both sides of a National Seal base sheet — which can be either DURA SEAL HD (FRICTION SEAL HD), or DURA SEAL LL (FRICTION SEAL LL).



FRICTION SEAL HD



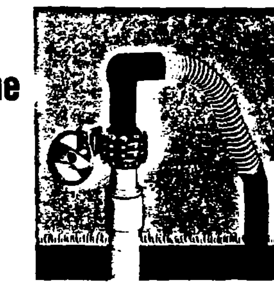
DURA SEAL LL liners offer greater flexibility, allowing increased conformance to subsidence and differential settlement. High elongation properties make these DURA SEAL LL liners ideal where conforming to irregularities in the subgrade would cause puncturing in other liners.



DURA SEAL HD the industry's most widely used material for lining both solid and hazardous waste landfills, is an excellent choice for tank linings and sludge ponds. DURA SEAL HD liners provide unequaled chemical resistance and impermeability. They also have exceptional ultraviolet light resistance, as well as excellent yield strength and seam strength.

Polyethylene Piping Systems

provide efficient landfill gas collection and leachate collection and transfer.



Polyethylene Piping Systems Complete installation services include prefabricated fittings, on-site fusion welding, and single source management and installation of piping systems to provide efficient extraction, collection and transfer of landfill gas (LFG) to an energy plant or flare, in compliance with EPA mandated gas collection requirements.

HYDROTEX fabric formed concrete liners

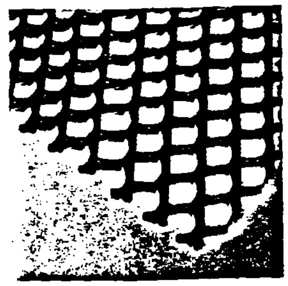
are a cost-effective alternative to rip rap and cast-in-place concrete.

HYDROTEX linings, mats and armor units are used in erosion control, scour protection and repair, foundation, environmental and marine construction applications. HYDROTEX is filled in place by pumping fine aggregate concrete into fabric forms, resulting in a durable, permanent erosion control layer which reduces material and equipment costs and speeds installation.

Be Used:

eonets

provide high transmissivity (flow of liquids and gases) for leachate collection, methane gas collection and leak detection layers in landfills, landfill caps, sludge ponds and sludge caps.

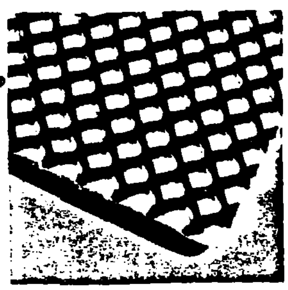


POLY-NET, an HDPE profiled mesh, can replace thick aggregate drainage systems employing materials such as sand or gravel. Installations are easier and more economical, because POLY-NET is lightweight and available in 14.5 foot (4.6 meter) wide rolls. And since POLY-NET is made from the same resin used in DURA SEAL HD, it's resistant to chemical degradation and biological attack.

Geosynthetic Clay Liners (GCLs)

can reduce or replace thick, time-consuming, expensive multi-lift clay liners in composite systems, caps and closures, secondary containment systems, liquid containment, and conveyance systems.

TEX-NET® ULTRA

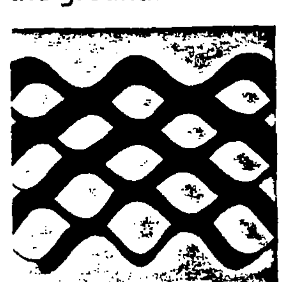


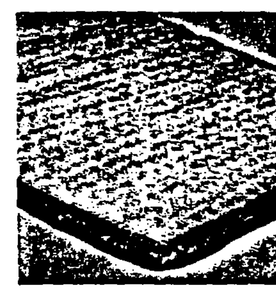
TEX-NET ULTRA geocomposite drainage system produced by heat bonding high-quality geotextiles to one or both sides of our POLY-NET geonet. The permeable textiles act as separators and filters, keeping soils, fines and waste out of leachate collection and leak detection layers. You can combine the TEX-NET Ultra geocomposite drainage system with FRICTION SEAL to increase interface friction angles, leading to even greater safety factors in steep slope design. TEX-NET Ultra provides higher flow rates and transmissivity than sand or standard geocomposites, easily exceeding EPA drainage media guidelines – with a significant safety factor.

GeoLok Cellular Confinement Systems

overcome the problems of poor soils for ground stabilization, slope protection, and retaining walls.

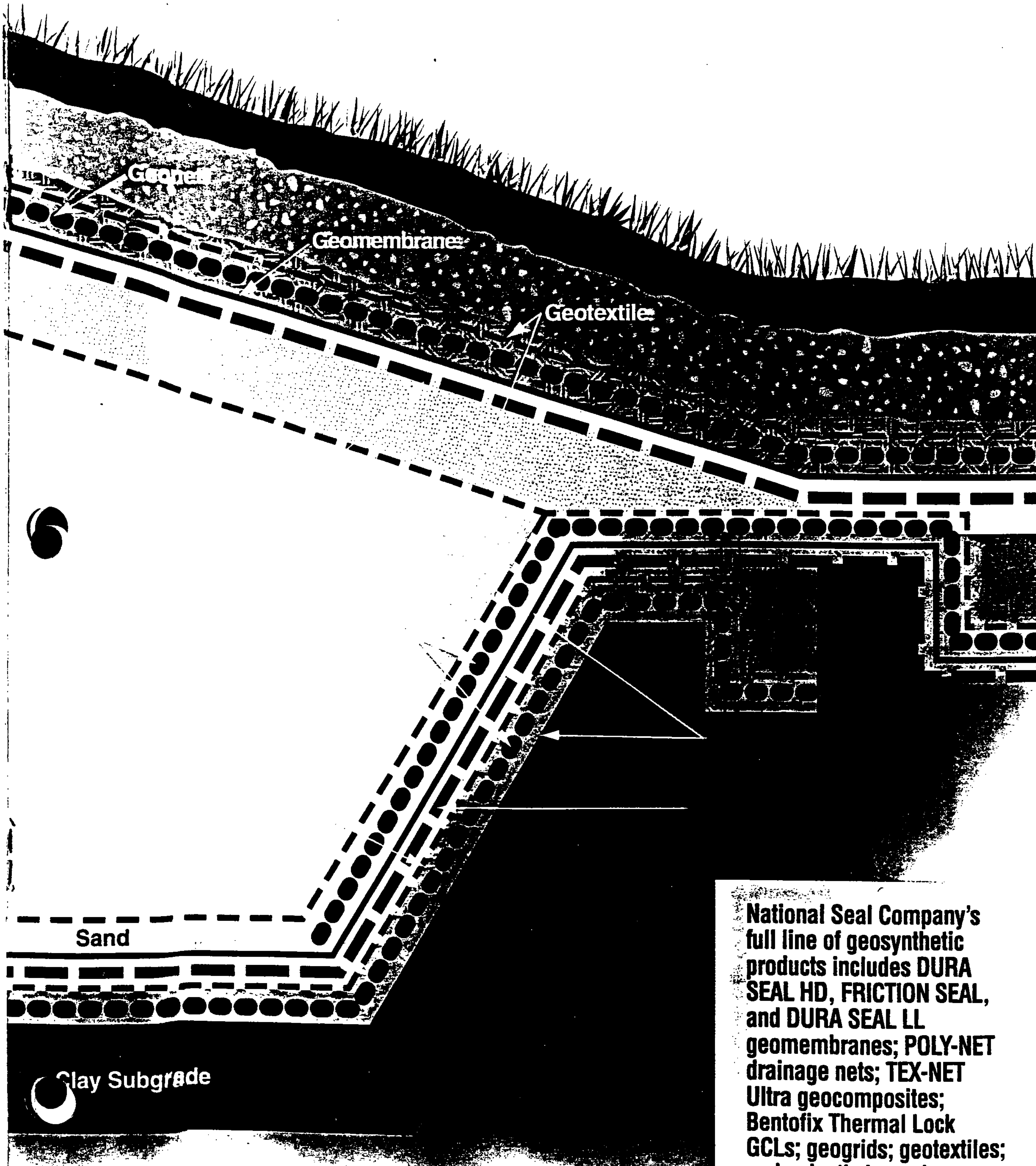
GeoLok Cellular Confinement Systems distribute loads laterally, reducing subgrade contact pressures to stabilize the ground. GeoLok cells confine fill material to prevent surface sloughing caused by wind and water.





Bentofix Thermal Lock GCL is a needlepunched composite containment liner which combines durable geotextile outer layers with an inner layer of low-permeability sodium bentonite. Bentofix Thermal Lock's needlepunched, thermally bonded fibers reinforce the bentonite layer, providing the composite with a high internal shear strength, making this the ideal GCL for steep slopes. While some GCLs are susceptible to shear failure even on shallow slopes, and others sacrifice permeability for higher shear properties, Bentofix's needlepunched, thermally bonded fibers reinforce the bentonite without compromising its hydraulic properties. Bentofix is available, through National Seal Company, for projects in North and South America.

Geosynthetics in a Typical National Seal Company Double-Composite Landfill Liner System



National Seal Company's full line of geosynthetic products includes DURA SEAL HD, FRICTION SEAL, and DURA SEAL LL geomembranes; POLY-NET drainage nets; TEX-NET Ultra geocomposites; Bentofix Thermal Lock GCLs; geogrids; geotextiles; and polyethylene pipe.

Solid Waste Landfills and Caps

With our complete line of geosynthetics — including DURA SEAL HD, DURA SEAL LL, and FRICTION SEAL geomembranes, POLY-NET geonets, TEX-NET Ultra geocomposites, Bentofix Thermal Lock GCLs, geogrids, geotextiles and polyethylene pipe — National Seal Company has the materials and expertise to ensure that your composite liner complies with Subtitle D of the Resource Conservation and Recovery Act (RCRA) or with other containment regulations.

Hazardous Waste Landfills

With 30.5 foot (9.3 meter) wide chemical- and UV-resistant HDPE liners — the widest flat sheet in the world — National Seal Company is well equipped to meet your hazardous waste landfill needs. Our liner materials meet the requirements of Subtitle C of RCRA. In addition, National Seal Company's installation group has extensive experience operating under hazardous waste conditions, including Level C remediation sites where protective gear is required.

Mining

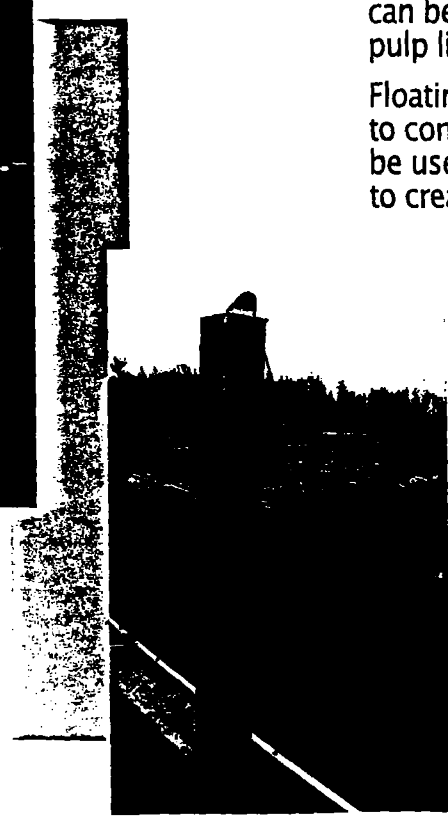
From our Western region and worldwide mining construction headquarters in Reno, Nevada, we can supply you with lining materials and installation services. These liners offer the chemical and UV resistance, flexibility, and elongation and puncture resistance needed to meet barrier and chemical requirements for mining applications — such as heap leach pads, tailings impoundments, and solution channels and ponds.

Ponds and Reservoirs

UV-resistant liners are easy and economical to install in ponds and reservoirs for water treatment, chemical storage, and wastewater treatment.

Wind-resistant floating covers reduce algae growth in potable and raw water reservoirs, prevent dilution of wastewater that must be treated, eliminate water collection in sludge ponds, and reduce treatment costs of waste chemicals that can be recycled (such as spent pulp liquor).

Floating covers can be used to control odors. Or they can be used as an oxygen barrier to create an anaerobic digestion condition in treatment systems for food processors, pulp mills, municipal treatment streams, and other industrial applications.



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GEOCOMPOSITE PROPERTIES

PROPERTY	TEST	UNITS	MINIMUM[2]	
			TN2001/1120	TN2001/1125
Transmissivity[1] (2,000 psf)	ASTM D 4716	m^2/sec	5×10^{-5}	3×10^{-5}
Ply Adhesion	ASTM D 413 or F 904	lb/in	2.0	2.0
Tensile Strength (MD)	ASTM D 4632	lbs	400	450

COMPONENT PROPERTIES[3]

GEONET	TEST	UNITS	PN 2000
Polymer Density	ASTM D 1505	g/cm^3	0.94
Carbon Black Content	ASTM D 4218	%	2.0
Thickness	ASTM D 5199	inches	0.160
Mass Per Unit Area	ASTM D 5261	lbs/ft^2	0.100
Transmissivity[1]	ASTM D 4716	m^2/sec	1×10^{-3} @ 2,000 psf
Tensile Strength	ASTM D 5035	lbs/in	30

GEOTEXTILE	TEST	UNITS	1120	1125
Fabric Weight	ASTM D 5261	oz/yd^2	5.7	7.1
Thickness	ASTM D 5199	mils	75	95
Grab Strength	ASTM D 4632	lbs	160	210
Water Flow Rate	ASTM D 4491	gpm/ft^2	130	110
AOS	ASTM D 4751	Sieve Size mm	70 0.210	70 0.210

1. Measured using water @ 20° C (68°F) with a gradient of one, between two steel plates, after one hour. Value may vary, based on dimensions of the transmissivity specimen and specific Laboratory.

2. These values represent minimum acceptable test values for a roll as tested according to NSC/FSI's Manufacturing Quality Control Manual. Individual test specimen values are not addressed in this specification.

3. Component properties are tested prior to the lamination process. They cannot be tested on the final product.

TN2001/1120/1125-0797

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GEOCOMPOSITE PROPERTIES

PROPERTY	TEST	UNITS	MINIMUM[2] TN2002/1120	TN2002/1125
Transmissivity[1] (2,000 psf)	ASTM D 4716	m^2/sec	8×10^{-5}	8×10^{-5}
Ply Adhesion	ASTM D 413 or F 904	lb/in	2.0	2.0
Tensile Strength (MD)	ASTM D 4632	lbs	400	450

COMPONENT PROPERTIES[3]

GEONET	TEST	UNITS	PN 2000
Polymer Density	ASTM D 1505	g/cm^3	0.94
Carbon Black Content	ASTM D 4218	%	2.0
Thickness	ASTM D 5199	inches	0.160
Mass Per Unit Area	ASTM D 5261	lbs/ft^2	0.100
Transmissivity[1]	ASTM D 4716	m^2/sec	$1x10^{-3}$ @ 2,000 psf
Tensile Strength	ASTM D 5035	lbs/in	30

GEOTEXTILE	TEST	UNITS	1120	1125
Fabric Weight	ASTM D 5261	oz/yd^2	5.7	7.1
Thickness	ASTM D 5199	mils	75	95
Grab Strength	ASTM D 4632	lbs	160	210
Water Flow Rate	ASTM D 4491	gpm/ft^2	130	110
AOS	ASTM D 4751	Sieve Size mm	70 0.210	70 0.210

1. Measured using water @ 20° C (68°F) with a gradient of one, between two steel plates, after one hour. Value may vary, based on dimensions of the transmissivity specimen and specific Laboratory.

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Information regarding the physical properties of National Seal Company products, including the information contained in this specification sheet, is, to the best of our knowledge, information and belief, representative of National Seal Company products. All information, data, suggestions, opinions and recommendations are offered without guarantee or warranty of any kind. The final determination as to the appropriateness or suitability of any National Seal Company product in any particular application rests with the user and is the user's sole responsibility.

National Seal Company reserves the right to alter, change or modify its products and its product specifications at any time without notice. Please check with your National Seal Company sales or technical representative to assure that specifications are current.

TN2002/1120/1125-0897

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GEOCOMPOSITE PROPERTIES

PROPERTY	TEST	UNITS	MINIMUM[2] TN3001/1120	TN3001/1125
Transmissivity[1] (15,000 psf)	ASTM D 4716	m^2/sec	5×10^{-5}	3×10^{-5}
Ply Adhesion	ASTM D 413 or F 904	lb/in	2.0	2.0
Tensile Strength (MD)	ASTM D 4632	lbs	450	500

COMPONENT PROPERTIES[3]

GEONET	TEST	UNITS	PN 3000
Density	ASTM D 1505	g/cm^3	0.94
Carbon Black Content	ASTM D 4218	%	2.0
Thickness	ASTM D 5199	inches	0.200
Mass Per Unit Area	ASTM D 5261	lbs/ft^2	0.162
Transmissivity[1]	ASTM D 4716	m^2/sec	1×10^{-3} @ 15,000 psf
Tensile Strength	ASTM D 5035	lbs/in	45

GEOTEXTILE	TEST	UNITS	1120	1125
Fabric Weight	ASTM D 5261	oz/yd^2	5.7	7.1
Thickness	ASTM D 5199	mils	75	95
Grab Strength	ASTM D 4632	lbs	160	210
Water Flow Rate	ASTM D 4491	gpm/ft^2	130	110
AOS	ASTM D 4751	Sieve Size mm	70 0.210	70 0.210

1. Measured using water @ 20° C (68°F) with a gradient of one, between two steel plates, after one hour. Value may vary, based on dimensions of the transmissivity specimen and specific laboratory.

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TN3001/1120/1125-0797

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GEOCOMPOSITE PROPERTIES

PROPERTY	TEST	UNITS	MINIMUM[2] TN3002/1120	MINIMUM[2] TN3002/1125
Transmissivity[1]	ASTM D 4716	m^2/sec	5×10^{-5}	3×10^{-5}
(15,000 psf)			1.5×10^{-4}(typ.)	1×10^{-4} (typ.)
Ply Adhesion	ASTM D 413 or F 904	lb/in	2.0	2.0
Tensile Strength (MD)	ASTM D 4632	lbs	535	580

COMPONENT PROPERTIES[3]

GEONET	TEST	UNITS	PN 3000
Density	ASTM D 1505	g/cm^3	0.94
Carbon Black Content	ASTM D 4218	%	2.0
Thickness	ASTM D 5199	inches	0.200
Mass Per Unit Area	ASTM D 5261	lbs/ft^2	0.162
Transmissivity[1]	ASTM D 4716	m^2/sec	1×10^{-3} @ 15,000 psf
Tensile Strength	ASTM D 5035	lbs/in	45

GEOTEXTILE	TEST	UNITS	1120	1125
Fabric Weight	ASTM D 5261	oz/yd^2	5.7	7.1
Thickness	ASTM D 5199	mils	75	95
Grab Strength	ASTM D 4632	lbs	160	210
Water Flow Rate	ASTM D 4491	gpm/ft^2	130	110
AOS	ASTM D 4751	Sieve Size	70	70
		mm	0.210	0.210

1. Measured using water @ 20° C (68°F) with a gradient of one, between two steel plates, after one hour. Value may vary, based on dimensions of the transmissivity specimen and specific laboratory.

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GEOCOMPOSITE PROPERTIES

PROPERTY	TEST	UNITS	MINIMUM[2]	
			TN3001CN/1120	TN3001CN/1125
Transmissivity[1] (4,000 psf)	ASTM D 4716	m^2/sec	8×10^{-5}	8×10^{-5}
Ply Adhesion	ASTM D 413 or F 904	lb/in	2.0	2.0
Tensile Strength (MD)	ASTM D 4632	lbs	450	450

COMPONENT PROPERTIES[3]

GEONET	TEST	UNITS	PN 3000CN
Density	ASTM D 1505	g/cm^3	0.94
Carbon Black Content	ASTM D 4218	%	2.0
Thickness	ASTM D 5199	inches	0.200
Mass Per Unit Area	ASTM D 5261	lbs/ft^2	0.140
Transmissivity[1]	ASTM D 4716	m^2/sec	1×10^{-3} @ 4,000 psf
Tensile Strength	ASTM D 5035	lbs/in	32

GEOTEXTILE	TEST	UNITS	1120	1125
Fabric Weight	ASTM D 5261	oz/yd^2	5.7	7.1
Thickness	ASTM D 5199	mils	75	95
Grab Strength	ASTM D 4632	lbs	160	210
Water Flow Rate	ASTM D 4491	gpm/ft^2	130	110
AOS	ASTM D 4751	Sieve Size	70	70
		mm	0.210	0.210

1. Measured using water @ 20° C (68°F) with a gradient of one, between two steel plates, after one hour. Value may vary, based on dimensions of the transmissivity specimen and specific laboratory.

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GEOCOMPOSITE PROPERTIES

PROPERTY	TEST	UNITS	MINIMUM[2]	
			TN3002CN/1120	TN3002CN/1125
Transmissivity[1] (4,000 psf)	ASTM D 4716	m^2/sec	5×10^{-5} 2×10^{-4} (typ.)	5×10^{-5} 1×10^{-4} (typ.)
Ply Adhesion	ASTM D 413 or F 904	lb/in	2.0	2.0
Tensile Strength (MD)	ASTM D 4632	lbs	535	580

COMPONENT PROPERTIES[3]

GEONET	TEST	UNITS	PN 3000CN
Density	ASTM D 1505	g/cm^3	0.94
Carbon Black Content	ASTM D 4218	%	2.0
Thickness	ASTM D 5199	inches	0.200
Mass Per Unit Area	ASTM D 5261	lbs/ft^2	0.140
Transmissivity[1]	ASTM D 4716	m^2/sec	1×10^{-3} @ 4,000 psf
Tensile Strength	ASTM D 5035	lbs/in	32

GEOTEXTILE	TEST	UNITS	1120	1125
Fabric Weight	ASTM D 5261	oz/yd^2	5.7	7.1
Thickness	ASTM D 5199	mils	75	95
Grab Strength	ASTM D 4632	lbs	160	210
Water Flow Rate	ASTM D 4491	gpm/ft^2	130	110
AOS	ASTM D 4751	Sieve Size mm	70 0.210	70 0.210

1. Measured using water @ 20° C (68°F) with a gradient of one, between two steel plates, after one hour. Value may vary, based on dimensions of the transmissivity specimen and specific laboratory.

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GEOCOMPOSITE PROPERTIES

PROPERTY	TEST	UNITS	MINIMUM[2]	
			TN5001/1120	TN5001/1125
Transmissivity[1] (15,000 psf)	ASTM D 4716	m^2/sec	1×10^{-4} 5×10^{-4} (typ)	1×10^{-4} 6×10^{-4} (typ)
Ply Adhesion	ASTM D 413 or F 904	lb/in	2.0	2.0
Tensile Strength (MD)	ASTM D 4632	lbs	450	450

COMPONENT PROPERTIES[3]

GEONET	TEST	UNITS	PN 5000
Density	ASTM D 1505	g/cm^3	0.94
Carbon Black Content	ASTM D 4218	%	2.0
Thickness	ASTM D 5199	inches	0.25
Mass Per Unit Area	ASTM D 5261	lbs/ft^2	0.2
Transmissivity[1, 4]	ASTM D 4716	m^2/sec	2×10^{-3} (1.5×10^{-3}) @ 15,000 psf
Tensile Strength	ASTM D 5035	lbs/in	50

GEOTEXTILE	TEST	UNITS	1120	1125
Fabric Weight	ASTM D 5261	oz/yd^2	5.7	7.1
Thickness	ASTM D 5199	mils	75	95
Grab Strength	ASTM D 4632	lbs	160	210
Water Flow Rate	ASTM D 4491	gpm/ft^2	130	110
AOS	ASTM D 4751	Sieve Size mm	70 0.210	70 0.210

1. Measured using water @ 20° C (68°F) with a gradient of one, between two steel plates, after one hour. Value may vary, based on dimensions of the transmissivity specimen and specific laboratory.

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3. Component properties are tested prior to the lamination process. They cannot be tested on the final product.

4. Some selected HDPE geomembrane sheet resins will achieve lower transmissivity values due to lower modulus. Specifying the same resin as used in the sheet on a project may limit the PN5000 to the 1.5×10^{-3} spec.

TN5001/1120/1125 - 0797

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GEOCOMPOSITE PROPERTIES

PROPERTY	TEST	UNITS	MINIMUM[2] TN5002/1120	MINIMUM[2] TN5002/1125
Transmissivity[1] (15,000 psf)	ASTM D 4716	m^2/sec	1×10^{-4} 5×10^{-4} (typ)	1×10^{-4} 6×10^{-4} (typ)
Ply Adhesion	ASTM D 413 or F 904	lb/in	2.0	2.0
Tensile Strength (MD)	ASTM D 4632	lbs	535	580

COMPONENT PROPERTIES[3]

GEONET	TEST	UNITS	PN 5000
Density	ASTM D 1505	g/cm^3	0.94
Carbon Black Content	ASTM D 4218	%	2.0
Thickness	ASTM D 5199	inches	0.25
Mass Per Unit Area	ASTM D 5261	lbs/ft^2	0.2
Transmissivity[1, 4]	ASTM D 4716	m^2/sec	2×10^{-3} (1.5×10^{-3}) @ 15,000 psf
Tensile Strength	ASTM D 5035	lbs/in	50

GEOTEXTILE	TEST	UNITS	1120	1125
Fabric Weight	ASTM D 5261	oz/yd^2	5.7	7.1
Thickness	ASTM D 5199	mils	75	95
Grab Strength	ASTM D 4632	lbs	160	210
Water Flow Rate	ASTM D 4491	gpm/ft^2	130	110
AOS	ASTM D 4751	Sieve Size mm	70 0.210	70 0.210

1. Measured using water @ 20° C (68°F) with a gradient of one, between two steel plates, after one hour. Value may vary, based on dimensions of the transmissivity specimen and specific laboratory.

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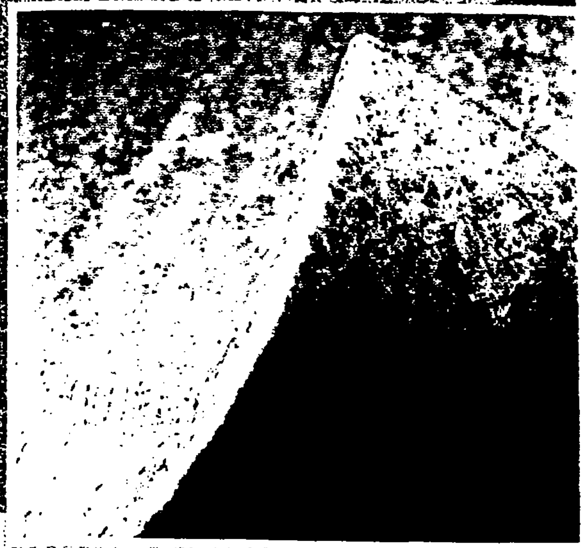
Bentofix

Thermal Lock Geosynthetic Clay Liners



NSC

National Seal Company

Thermal locking enhances shear strength of needlepunched fibers. High quality, natural sodium bentonite provides low permeability.

Needlepunching Makes a Difference

By needlepunching fibers through the sodium bentonite clay layer, a completely uniform, reinforced GCL is produced — with shear strength and stability advantages important to any application.

High Shear Resistance

Needlepunching reinforces the otherwise weak layer of sodium bentonite clay. Unreinforced bentonite is susceptible to shear failure, even on gentle slopes.

The Bentofix Thermal Lock GCL needlepunching process consistently reinforces the bentonite layer with thousands of high tenacity fibers that resist and transfer the shearing stresses into the encapsulating geotextiles.

Uniform Bentonite Content

The uniform confinement provided by the fibers from the needlepunching process resist lateral migration of the bentonite clay within the Bentofix Thermal Lock GCL — in either the dry or hydrated state. As a result, a consistent bentonite content is preserved throughout the composite, in turn resulting in a consistently low permeability.

Greater Installation Durability

During installation, the needlepunched fibers hold the bentonite in place and prevent the GCL from separating. Bentofix Thermal Lock GCL is more durable over a wider range of installation conditions, and, because it is needle-punched, it can greatly reduce the adverse effects of premature hydration during installation.

Superior GCL Performance

With Bentofix Thermal Lock GCLs, the clay component is no longer the limiting factor on side slopes. You can use Bentofix Thermal Lock GCLs to replace compacted clay layers on steep side slopes and be assured of low permeability without sacrificing slope stability. The inherent confining stress from the needlepunching also improves the hydraulic properties of Bentofix Thermal Lock GCLs under low confining stress applications.

Assured Quality Control

Because Bentofix Thermal Lock GCLs are factory manufactured liner products, the controlled environment of the production facility allows for greater control over critical performance characteristics. The intensive Bentofix Thermal Lock GCL quality control program ensures consistent hydraulic and physical properties through the latest ASTM procedures.

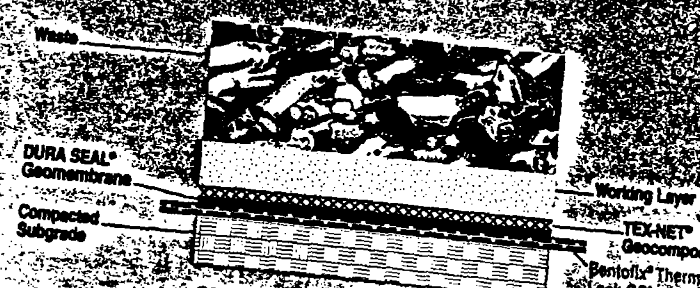
The thorough manufacturing quality control minimizes the expensive and time consuming on-site quality assurance testing required for compacted clay liners. Bentofix Thermal Lock GCL provides consistent high quality performance.

Bentofix Thermal Lock Is More Versatile Than Compacted Clay

Bentofix Thermal Lock GCLs are part of an important trend toward the combined use of geosynthetics and clay materials in containment applications. In a typical composite liner system, GCLs work synergistically with polyethylene and other geomembrane materials to maximize liner system efficiency.

Increased Airspace and Liner Efficiency

In a composite landfill liner system, Bentofix Thermal Lock GCLs can in many cases completely replace, or significantly reduce, the required thickness of the compacted clay layer. This results in less excavation and recompaction, as well as increased containment volume. And, in a landfill, increased airspace means increased revenues.

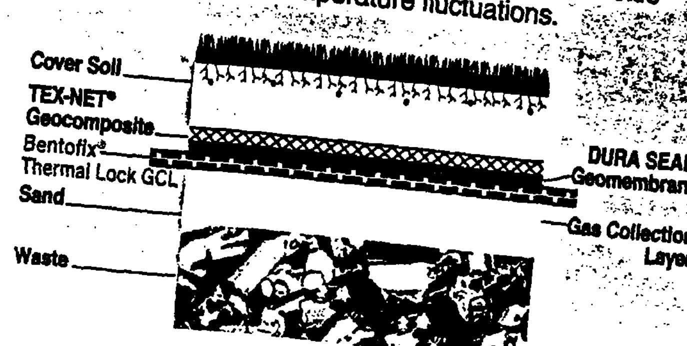


Single-composite liner system

Double-composite liner system

Caps and Closures

Bentofix Thermal Lock GCLs are ideally suited for use in landfill caps and closures. Used alone, or in conjunction with a geomembrane, Bentofix Thermal Lock GCLs are resistant to the deleterious effects of differential settlement and seasonal temperature fluctuations.



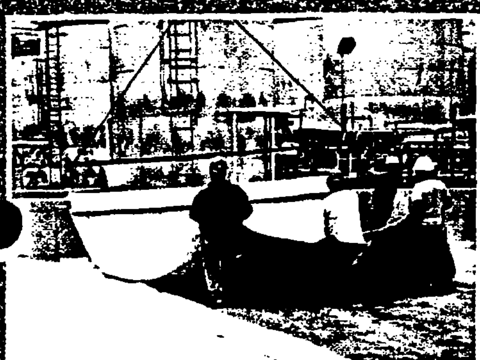
Landfill composite cap

Bentofix® Thermal Lock Geosynthetic Clay Liner

Applications

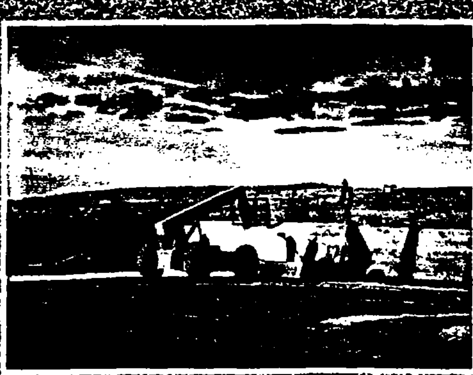
Composite Linings

Bentofix Thermal Lock GCLs can [illegible]



Secondary Containment

Bentofix Thermal Lock GCLs [illegible] secondary containment [illegible] Due to the ease of installation and virtually effortless pipe penetration construction.



Liquid Containment [illegible] Canals

Bentofix Thermal Lock GCLs provide exceptional liquid containment in reservoirs and irrigation canals as well as industrial ponds and lagoons, due to their low permeability and high internal shear strength.

Bentofix Thermal Lock Geosynthetic Clay Liners (GCLs) are needle-punch reinforced composites which combine two durable geotextile outer layers with a uniform core of natural sodium bentonite clay to form a hydraulic barrier.

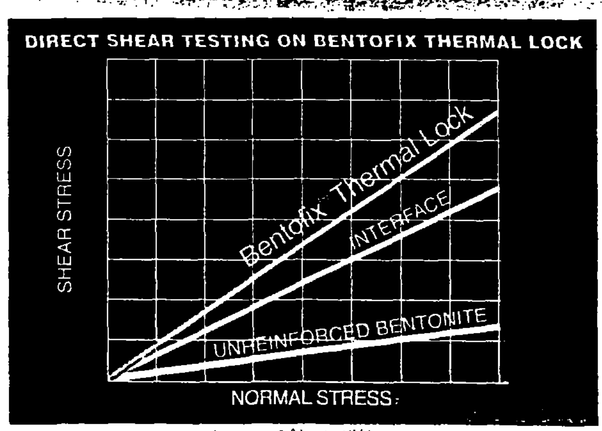
The sodium bentonite clay utilized in Bentofix Thermal Lock GCL is a naturally occurring clay mineral that swells as water enters between its clay platelets. When hydrated under confinement, the bentonite swells to form a low permeability clay layer with the equivalent hydraulic protection of several feet of compacted clay.

Bentofix Thermal Lock GCLs are produced by distributing a uniform layer of the sodium bentonite between two geotextiles.

CROSS SECTION OF BENTOFIX THERMAL LOCK GEOSYNTHETIC CLAY LINER

Fibers from the non-woven geotextile are then needlepunched through the layer of bentonite and incorporated into the other geotextile (either a woven or a non-woven). This process results in a strong mechanical bond between the fabrics.

A proprietary heat treating process — the Thermal Lock process — is then used to modify and more permanently lock the needle-punched fibers into place. Unique properties, including increased internal shear resistance and long term creep resistance, result from this procedure.

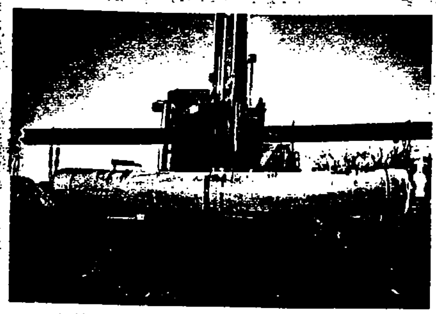


Bentofix Thermal Lock's internal friction angle is higher than those typically found elsewhere in a multi layer lining system.*

*In all applications, design-specific parameters will affect the actual results obtained. Site-specific testing is recommended to determine the shear strengths for each application.

Bentofix Thermal Lock is Easy to Install

Combining low permeability and high internal shear strength, Bentofix Thermal Lock is an exceptionally easy to use hydraulic barrier. Bentofix Thermal Lock GCLs are the widest geotextile based GCLs in the industry. The widest width, coupled with available custom lengths, makes Bentofix Thermal Lock the most versatile GCL available.



1) To install Bentofix Thermal Lock, a core bar is inserted through the core, and the roll is suspended from a spreader bar. The roll is then either unrolled, or the free end is secured in an anchor trench and the suspended roll is slowly backed away.

2) A clearly marked lap-line and match-line are indicated on each panel edge to indicate the correct overlap zone. Granular bentonite may be used to augment the seal at the overlap as required by the specific application.

3) No special tools are required to cut Bentofix Thermal Lock GCLs. A utility knife is all that is needed to cut the Bentofix Thermal Lock into any configuration.

4) GCLs must be properly confined by a minimum soil cover before being allowed to hydrate.

5) Detailed installation recommendations may be found in the Bentofix Thermal Lock Geosynthetic Clay Liner Installation Guidelines.

Simple, cost-effective installation techniques make Bentofix Thermal Lock GCL a practical alternative to a compacted clay liner for a wide range of applications, including composite landfill liners, landfill caps, secondary containment, storm water and waste water impoundments, as well as canals, dams and reservoirs.

Call **National Seal Company at (800) 323-3820** for more details on how Bentofix Thermal Lock Geosynthetic Clay Liners can provide you with better hydraulic properties, greater shear strength, simpler installation and greater durability for your next lining project.

National Seal Company
http://www.nationalseal.com

BENTOFIX® THERMAL LOCK "NW"

GEOSYNTHETIC CLAY LINER (GCL) CERTIFIED PROPERTIES AND TEST FREQUENCIES

Bentofix Thermal Lock "NW" is a needlepunch reinforced GCL comprised of a uniform layer of granular sodium bentonite encapsulated between a scrim reinforced nonwoven and a virgin staple fiber nonwoven cap geotextile. The protruding needlepunched fibers are then thermally fused to the scrim reinforced nonwoven geotextile to further enhance the reinforcing bond.

FINISHED GCL PROPERTIES	TEST METHOD	MINIMUM TEST FREQUENCY	VALUE - ENGLISH -	VALUE - SI -
Bentonite Mass Per Unit Area[1]	ASTM D 5993	1/40,000 sq. ft (1/4,000 sq. m)	0.893 lb. / sq. ft MARV	4.34 kg / m^2 MARV
Grab Strength[2]	ASTM D 4632	1/40,000 sq. ft (1/4,000 sq. m)	150 lbs MARV	667 N MARV
Grab Elongation[2]	ASTM D 4632	1/40,000 sq. ft (1/4,000 sq. m)	150 % Typical	150 % Typical
Peel Strength[3]	ASTM D 4632	1/40,000 sq. ft (1/4,000 sq. m)	15 lbs. min.	66 N
Permeability[4]	ASTM D 5084	1/100,000 sq. ft (1/10,000 sq. m)	5×10^{-9} cm/sec max	5×10^{-9} cm/sec max
Index Flux[4]	ASTM D 5887	1/Week	1×10^{-8} m^3/m^2/sec max	1×10^{-8} m^3/m^2/sec max
Internal Shear Strength[5]	ASTM D 5321	Periodic	500 psf Typical	24 kPa Typical
DIMENSIONS				
Width x Length	nominal	Every Roll	15.5 x 150 ft	4.7 x 45.72 m
Area per Roll	nominal	Every Roll	2325 ft^2	216 m^2
Packaged Weight	typical	Every Roll	2600 lbs	1179 kg

GEOTEXTILE PROPERTIES	TEST METHOD	MINIMUM TEST FREQUENCY	VALUE - ENGLISH -	VALUE - SI -
Cap Nonwoven - 1 Mass/Unit Area	ASTM D 5261	1/200,000 sq. ft (1/20,000 sq. m)	6.0 oz./yd^2 MARV	200 g / m^2 MARV
Scrim Nonwoven - 2 Mass/Unit Area	ASTM D 5261	1/200,000 sq. ft (1/20,000 sq. m)	6.0 oz./yd^2 MARV	200 g / m^2 MARV
BENTONITE PROPERTIES				
Swell Index	ASTM D 5890	1/100,000 lbs. (50,000 kg)	24 ml / 2g min.	24 ml / 2g min.
Moisture Content	ASTM D 4643	1/100,000 lbs. (50,000 kg)	12 % max.	12 % max.
Fluid Loss	ASTM D 5891	1/100,000 lbs. (50,000 kg)	18 ml max.	18 ml max.

1. Oven-dried measurement. Equates to 1.0 lbs when indexed to a 12% moisture content.
2. Measured at maximum peak, in the weakest principal direction.
3. Modified to use a 4 inch wide grip. The maximum peak of five specimens averaged.
4. De-Aired Tap Water @ 5 psi maximum effective confining stress and 2 psi head.
5. Typical peak value for specimen hydrated for 24 hr. and sheared under a 200 psf normal stress.

BFNW-0598

NSC

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BENTOFIX® THERMAL LOCK "NS"

GEOSYNTHETIC CLAY LINER (GCL) CERTIFIED PROPERTIES AND TEST FREQUENCIES

Bentofix Thermal Lock "NS" is a needlepunch reinforced GCL comprised of a uniform layer of granular sodium bentonit encapsulated between a slit-film woven and a virgin staple fiber nonwoven geotextile. The protruding needlepunche fibers are then thermally fused to the woven geotextile scrim to further enhance the reinforcing bond.

FINISHED GCL PROPERTIES	TEST METHOD	MINIMUM TEST FREQUENCY	VALUE - ENGLISH -	VALUE - SI -
Bentonite Mass Per Unit Area[1]	ASTM D 5993	1/40,000 sq. ft (1/4,000 sq. m)	0.893 lb. / sq. ft MARV	4.34 kg / m^2 MARV
Grab Strength[2]	ASTM D 4632	1/40,000 sq. ft (1/4,000 sq. m)	95 lbs MARV	422 N MARV
Grab Elongation[2]	ASTM D 4632	1/40,000 sq. ft (1/4,000 sq. m)	150 % Typical	150 % Typical
Peel Strength[3]	ASTM D 4632	1/40,000 sq. ft (1/4,000 sq. m)	15 lbs. min.	66 N
Permeability[4]	ASTM D 5084	1/100,000 sq. ft (1/10,000 sq. m)	5×10^{-9} cm/sec max	5×10^{-9} cm/sec max
Index Flux[4]	ASTM D 5887	1/Week	1×10^{-8} m^3/m^2/sec max	1×10^{-8} m^3/m^2/sec max
Internal Shear Strength[5]	ASTM D 5321	Periodic	500 psf Typical	24 kPa Typical
DIMENSIONS				
Width x Length	nominal	Every Roll	15.5 x 150 ft	4.7 x 45.72 m
Area per Roll	nominal	Every Roll	2325 ft^2	216 m^2
Packaged Weight	typical	Every Roll	2600 lbs	1179 kg
GEOTEXTILE PROPERTIES	**TEST METHOD**	**MINIMUM TEST FREQUENCY**	**VALUE - ENGLISH -**	**VALUE - SI -**
Cap Nonwoven Mass/Unit Area	ASTM D 5261	1/200,000 sq. ft (1/20,000 sq. m)	6.0 oz./yd^2 MARV	200 g / m^2 MARV
Woven Scrim Mass/Unit Area	ASTM D 5261	1/200,000 sq. ft (1/20,000 sq. m)	3.1 oz./yd^2 MARV	105 g / m^2 MARV
BENTONITE PROPERTIES				
Swell Index	ASTM D 5890	1/100,000 lbs. (50,000 kg)	24 ml / 2g min.	24 ml / 2g min.
Moisture Content	ASTM D 4643	1/100,000 lbs. (50,000 kg)	12 % max.	12 % max.
Fluid Loss	ASTM D 5891	1/100,000 lbs. (50,000 kg)	18 ml max.	18 ml max.

1. Oven-dried measurement. Equates to 1.0 lbs when indexed to a 12% moisture content.
2. Measured at maximum peak, in the weakest principal direction.
3. Modified to use a 4 inch wide grip. The maximum peak of five specimens averaged.
4. De-Aired Tap Water @ 5 psi maximum effective confining stress and 2 psi head.
5. Typical peak value for specimen hydrated for 24 hr. and sheared under a 200 psf normal stress.

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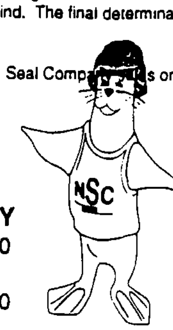

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APPENDIX 4-2

I-2 CONSTRUCTION QUALITY ASSURANCE AND QUALITY CONTROL PLAN

1 Quality Assurance Organization and Responsibilities

The Owner will have ultimate responsibility for activities undertaken at the site, including responsibility for overseeing construction. A qualified construction firm will be selected for this project. The Owner or his Engineer will provide guidance to the selected firm during construction. an independent registered professional engineer in the State of Illinois will provide inspections, as necessary, to ensure that construction of the final cover is conducted within prudent engineering principals. The independent professional engineer will then certify the construction of the final cover. Figure 1 depicts the organizational chart for this construction project.

<u>Owner</u>

The Owner will have the ultimate responsibility for the construction of the final cover. The Owner has the authority to commit the necessary resources to accomplish closure. The Owner will be kept apprised of progress and situations involved with closure by his Engineer. The Owner will inform IEPA when closure activities begin and are completed.

<u>Contracted Construction Firm</u>

A qualified construction firm will be retained by the Owner to accomplish closure. The firm will be managed by competent individuals who have had prior experience with these types of construction operations. The firm will follow construction designs and specifications that will be developed and approved for the closure activities.

<u>Owner's Engineer</u>

The Owner's Engineer will act as liaison between the Owner and the construction firm. He shall coordinate all construction activities with the contracted firm and immediately report any problems or deviations from designed construction operations to the Owner. He will be involved in the day-to-day management of construction activities at the closure site.

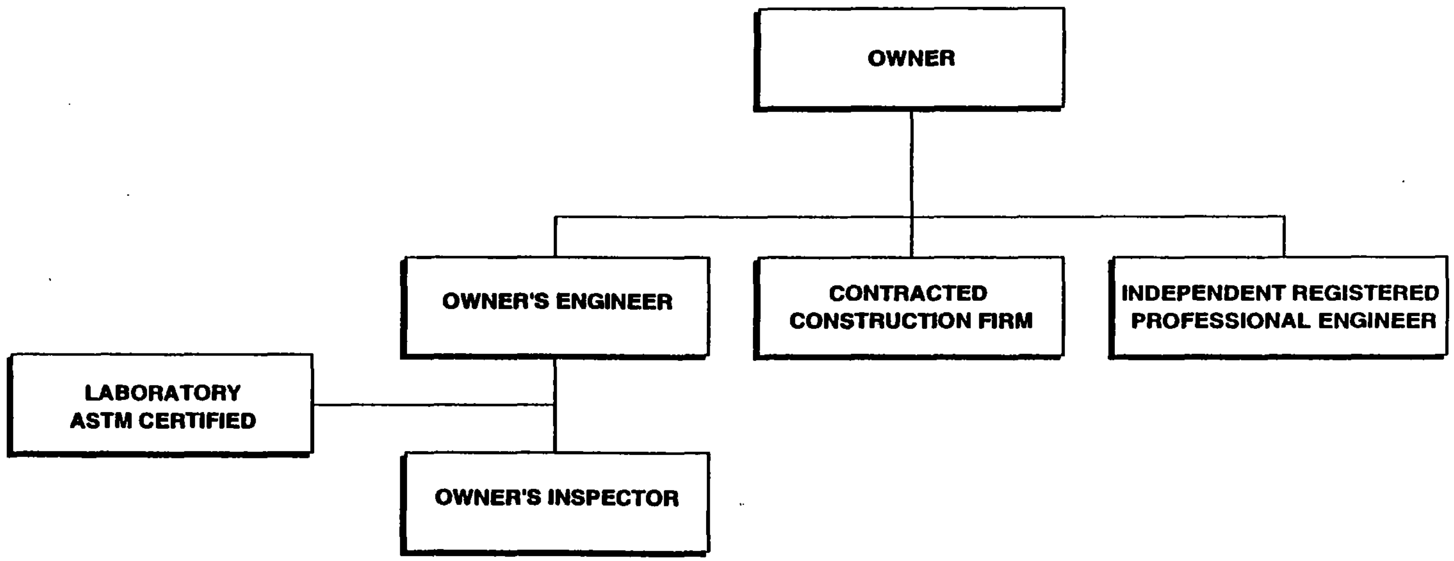


FIGURE 1
Closure Construction Project Organization Chart

Owner's Inspector

The Owner's Inspector shall observe the daily construction activities of the final cover. He will immediately report any problems or deviations from design specifications or drawings to the Owner's Engineer. The inspector will collect the required number of samples needed to ensure the final cover has met all the design standards and ship them to a laboratory certified to conduct soil analysis.

Laboratory

The laboratory will analyze all soil samples according to the ASTM methods stipulated in the next section of this QA/QC Plan. The laboratory will be staffed with professionals experienced in soil analysis and shall be certified to conduct ASTM analysis.

Registered Professional Engineer

An independent registered professional engineer will inspect closure activities to ensure that closure has been conducted pursuant to 35 Ill. Adm. Code 725.410 requirements. The engineer will certify and seal all certification documentation and send such documentation to the IEPA after closure activities are completed.

0.1 Closure Construction Testing Protocol

Soil Source Acceptance

The contractor will test each offsite source of backfill, clay cover, and topsoil that is proposed to be used in the cover system. The following test results will be submitted to the Owner before acceptance of any soil material:

- Backfill testing for moisture-density relationship.
- Clay cover testing for moisture content, grain size distribution, specific gravity, liquid and plastic limits, moisture-density relationship, and hydraulic conductivities at 85, 90, and 95 percent of standard Proctor maximum dry density at various moisture contents.
- Topsoil testing for acidity and organic content.

The soils shall be tested by an ASTM-certified laboratory, which shall provide QA/QC documentation on procedures and calibration. The allowable test methods and acceptance criteria are provided in Table 1. The Owner's Inspector will sample each initially accepted material and repeat the above analyses prior to final acceptance and use of any of the materials

TABLE 1

Soil Acceptance Test Methods and Criteria

Parameter	Test Method	Acceptance Criteria
Moisture-Density Relationship	ASTM D-698	None*
Moisture Content	ASTM D-2216	None*
Grain Size Distribution	ASTM D-422	100% finer than 0.75 inch, 30% finer than No. 200
Specific Gravity	ASTM D-854	None
Liquid/Plastic Limits	ASTM D-4318	Liquid Limit >30% Plasticity
Hydraulic Conductivity	ASTM D-2434	index $\geq 10^{-7}$ cm/sec
Acidity		pH = 5.0 - 7.5
Organic Content		O.C. ≥2.75%

*No limits, but test must conclusively show material characteristics to the satisfactino of the Owner's Engineer.

in onsite construction. Sampling and analysis may be repeated at any time during construction, and material acceptance may be suspended or revoked based on such tests.

Constructed Cover Acceptance

The Owner's Inspector will perform in-place density tests on constructed sections of backfill and clay final cover, to verify proper compaction and minimum permeabilities. Test methods, frequencies, and acceptance criteria are provided in Table 2. Tested sections failing acceptance criteria will be reworked, or removed and replaced, by the contractor until meeting such criteria.

2. Recordkeeping

All construction and sampling activities will be documented by the Owner's Engineer. The documentation will be in the form of field records and will contain all activities conducted during construction, including any deviance from design plans and specification. Any physical anomaly that may affect the construction of the final cover will be denoted as well (i.e., weather). A copy of the field record will be submitted to IEPA with the closure certification documents. The original field records will be archived by the Owner until the end of post-closure care.

TABLE 2

Constructed Cover In-Place Test Methods and Acceptance Criteria

Parameter	Frequency	Test Method	Acceptance Criteria
Backfill Density	1/lift/day	ASTM D-2922	90% of maximum dry density
Clay Cover Density	1/lift/day	ASTM D-2922	In range to provide H.C. $<10^{-7}$ cm/sec.

5. COOLING WATER CANAL CLOSURE AND POST-CLOSURE PLANS

5.1 Overview

The cooling water canal consisted of a 30 to 40 foot wide channel excavated in the native clayey soil to a depth of about 10 feet, running along the north and east sides of the site with two (2) legs extending into the center, as shown in Figure 5-1. The canal on the east originally ran as far south as 150 feet from the SE corner, as shown on Drawing L-9100-100 contained in Section IV of Chemetco's 1986 "Comprehensive Proposal" report to IEPA. Due to construction of the east drying pad, the south leg of the canal was cut back several hundred feet, as shown on the aerial photograph of December 1980, to the dimensions shown in ENSR's October 1988 Partial Closure Plan. The canal was removed from service in 1985 by de-watering and removal of subsoils. Soil testing demonstrated levels of lead and cadmium below EP Toxicity standards. Since waste materials have already been removed and only residual constituents remain in this unit, Chemetco will continue to conduct groundwater monitoring in accordance with 35 Ill. Adm. Code, Part 724, Subpart F.

5.2 Activities Completed to Date

Closure of the cooling water canal began in July and was completed in September 1985. Water in the canal was removed using two (2) 400 gpm pumps at the northwest end of the canal. A crawler loader excavated the soils from the canal sides and bottom. Excavated material was transported from the canal to the zinc oxide storage bunker in dump trucks.

A sampling grid, shown in Figure 5-2, was established prior to the cleaning operation. The majority of the canal was divided into 75-foot intervals except at the ends where the intervals varied from 10-feet to 40-feet because either the zinc oxide in the canal was a small quantity, the length to width ratio was greater than 80:1 or the material was deposited on the canal bottom only. Samples were taken on a longitudinal center line only. A total of forty-eight (48) samples were collected, and because of the known chemistry of the zinc oxide material, the soil was tested and analyzed using the EP Toxicity Test for lead and cadmium only. Analyses were performed in accordance with SW-846, Test Methods for Evaluating Solid Waste - Physical and Chemical Methods, 1982.

When lead and cadmium levels exceeded the EP Toxicity thresholds, soils were excavated until lead and cadmium were not detected (see Table 5-1, enclosed, and Appendix I of July 1990 Closure and Post-Closure Plans submitted by Chemetco). These levels are below EP Toxicity standards for lead and cadmium. When soil analyses demonstrated the absence of lead and cadmium, portions of the canal were filled with slag. An estimated eighty percent (80%) of the cooling water canal was filled with approximately 255,370 tons of slag, as shown by the cross-hatching in Figure 5-3.

Closure was interrupted in 1986 when the IEPA analyses found EP Toxic lead concentrations in soils in the canal. At that time closure activities ceased and equipment was decontaminated.

The 400 gpm pumps used for water level control and located on the north end of the canal did not show evidence of zinc oxide contamination. After being thoroughly flushed with clear water, the pumps have been used in a stormwater runoff control system. The dump trucks used to transport the zinc oxide and soil removed from the canal were scraped and washed at the end of each working day. The cleaning was performed in the concreted "AAF" area near the sump and a pump used to return the wash water to the "AAF" system to reclaim the zinc oxide material. A plant high pressure water system supplied the water. The cleaning included the dump bed, undercarriage, and tires. When Chemetco stopped closing the canals, the crawler type backhoe was cleaned with the same washing system in the same area. Prior to that time, the backhoe was restricted to the immediate area of the cooling canal.

5.3 Closure Procedures

Two (2) portions of the canal were not closed during the initial closure activities in 1986 since the IEPA found concentrations of lead in the soils in excess of the EP Toxicity standards. Figure 5-3 shows the remaining "open" portions of the canal. This open canal currently is used as a stormwater retention pond. The cooling canals will be closed in the following manner:

The open portion of the canals will be dewatered. The storm water currently contained within these canals will be fed into the AAF scrubber ponds as make up water. Any sediment present in the bottom of the canals will be excavated and placed into the zinc oxide bunker, designated as a CAMU. After removal of any sediment, soil samples will be collected from the bottom of the canals. Twelve sample locations were proposed by CSD in the January 16, 1996 Sampling & Analysis Plan for the Zinc Oxide Lagoons and Cooling Water Canals. Refer to Appendix 5-1 for a copy of the plan and the Agency's response dated March 14, 1997. However, one sample location is proposed to be deleted since this portion of the canal was concreted many years ago. Refer to Figure 5-4 for the proposed sampling locations. The soil samples will be collected in accordance with the January 16, 1996 Sampling & Analysis Plan and IEPA letter dated March 14, 1997. The cooling canals will be closed in the "as is" state with a modified RCRA cap consisting of asphalt or concrete.

The covered portion of the canals will be closed in the "as is" state, Chemetco is requesting the IEPA determine that the levels remaining are not significant and will deem placement of a RCRA cap or additional remediation as unnecessary to provide long term minimization of migration of liquids as required by 35 Ill. Adm. Code,725.410(a).

Chemetco will conduct post-closure groundwater monitoring, using existing wells, in accordance with 35 Ill. Adm. Code, Part 724, Subpart F.

5.4 Post-Closure Care

Post-closure care will begin after completion of the closure certification and will continue for thirty (30) years, unless the care period is shortened or extended by IEPA. Post-closure care will consist of groundwater monitoring as described in Section 3.

The facility contact during the post-closure care period is:

Environmental Manager
Chemetco, Inc.

P.O. Box 67
Hartford, Illinois 62048
(618) 254-4381

5.5 Certifications and Notices

During the closure activity and post-closure care, an independent, registered professional engineer will conduct periodic inspections to ensure that all critical activities are completed adequately and in accordance with the approved Closure and Post-Closure Plans.

Within sixty (60) days of completion of closure, Chemetco will submit by registered mail to the Administrator of USEPA Region V and the Director of the IEPA certification by Chemetco and an independent professional engineer registered in the State of Illinois that the facility has been closed in accordance with the approved closure plan. Likewise, within sixty (60) days of completion of post-closure care, certification will be submitted that the approved post-closure plan was followed. The certification will be signed by a responsible corporate officer, or duly authorized representative, and will contain the certification statement required under 35 Ill. Adm. Code Subtitle G, Section 702.126.

Chemetco will submit a survey plat at the time of closure certification to both IEPA and the local zoning authority. The plat will indicate the location of the cooling water canal with respect to permanently surveyed benchmarks, will note that the area's future use is restricted, and will be prepared and certified by a professional land surveyor. Within sixty (60) days of closure certification, Chemetco will submit a record of types, amounts, and location of waste materials or residuals in the cooling water canal to both IEPA and the local zoning authority. Within sixty (60) days of closure certification, Chemetco will also record a notation on the property deed and submit certification that such a notation has been made in accordance with 35 Ill. Adm. Code 724, Subpart G. This notation will alert any potential purchaser of the property that the land has been used to manage hazardous waste and its future use is restricted to a shallow-rooted grassland or non-residential or commercial development (i.e., parking area).

Within sixty (60) days of completion of the post-closure care period, Chemetco will submit to the Agency, by registered mail, a certification, signed by a responsible corporate officer, or duly authorized representative, and an independent registered professional engineer, that the activities during the post-closure care period were performed in accordance with the specifications in the approved post-closure plan.

5.6 Closure Schedule

Within 180 days of approval of the zinc oxide bunker as a CAMU, Chemetco will initiate sampling and analysis activities associated with the closure demonstration of the cooling canals. A "closure" report and certification of closure documenting the completed sampling and analysis activities will be submitted to the IEPA within 180 days, if possible. Refer to Figure 5-5 illustrating the closure plan schedule for the cooling canal. Post-closure care of this unit will not commence until final plant closure.

TABLE 5-1

Summary EP Toxicity Test Results
Cooling Water Canal

Sample No.	Lead	Cadmium	Lab
1A	BDL	BDL	ERT
2A	BDL	BDL	ERT
3A	BDL	BDL	ERT
4A	BDL	BDL	ERT
5A	BDL	BDL	ERT
6A	BDL	BDL	ERT
7A	BDL	BDL	ERT
8A	BDL	BDL	ERT
9A	BDL	BDL	ERT
10A	BDL	BDL	ERT
11A	BDL	BDL	ERT
12A	BDL	BDL	ERT
13A	BDL	BDL	ERT
14A	BDL	BDL	ERT
15A	BDL	BDL	ERT
16A	BDL	BDL	ERT
17A	BDL	BDL	ERT
18A	BDL	BDL	ERT
19A	BDL	BDL	ERT
20A	BDL	BDL	ERT

TABLE 5-1 (Cont'd)

Summary EP Toxicity Test Results
Cooling Water Canal

Sample No.	Lead	Cadmium	Lab
21A	BDL	BDL	ERT
22A	BDL	BDL	ERT
23A	BDL	BDL	ERT
24A	BDL	BDL	ERT
25A	BDL	BDL	ERT
26A	BDL	BDL	ERT
27A	BDL	BDL	ERT
28A	BDL	BDL	ERT
29A	BDL	BDL	ERT
30A	BDL	BDL	ERT
31A	BDL	BLD	ERT
32A	BDL	BDL	ERT
33A	BDL	BDL	ERT
34A	BDL	BDL	ERT
35A	BDL	BDL	ERT
36A	BDL	BDL	ERT
37A	BDL	BDL	ERT
38A	BDL	BDL	ERT
39A	BDL	BDL	ERT
40A	BDL	BDL	ERT
41A	BDL	BDL	ERT

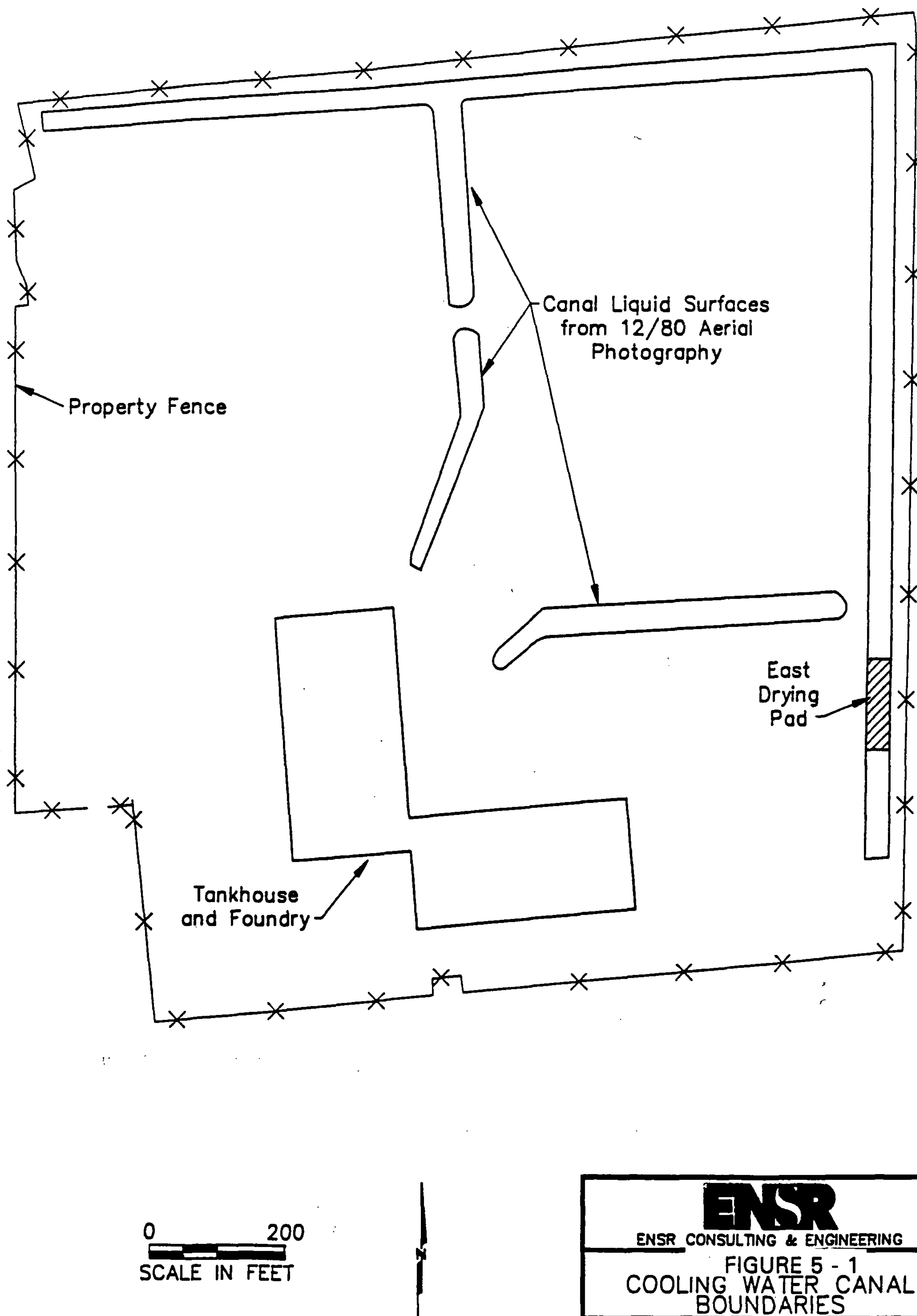
TABLE 5-1 (Cont'd)

Summary EP Toxicity Test Results
Cooling Water Canal

Sample No.	Lead	Cadmium	Lab
42A	BDL	BDL	ERT
43A	BDL	BDL	ERT
44A	BDL	BDL	ERT
45A	BDL	BDL	ERT
45A	BDL	BDL	ERT
46A	BDL	BDL	ERT
47A	BDL	BDL	ERT
48A	BDL	BDL	ERT
49A	BDL	BDL	ERT
50A	BDL	BDL	ERT

Detection Limit: 0.05 mg/l

Analytical Method: SW 846 Method 6010



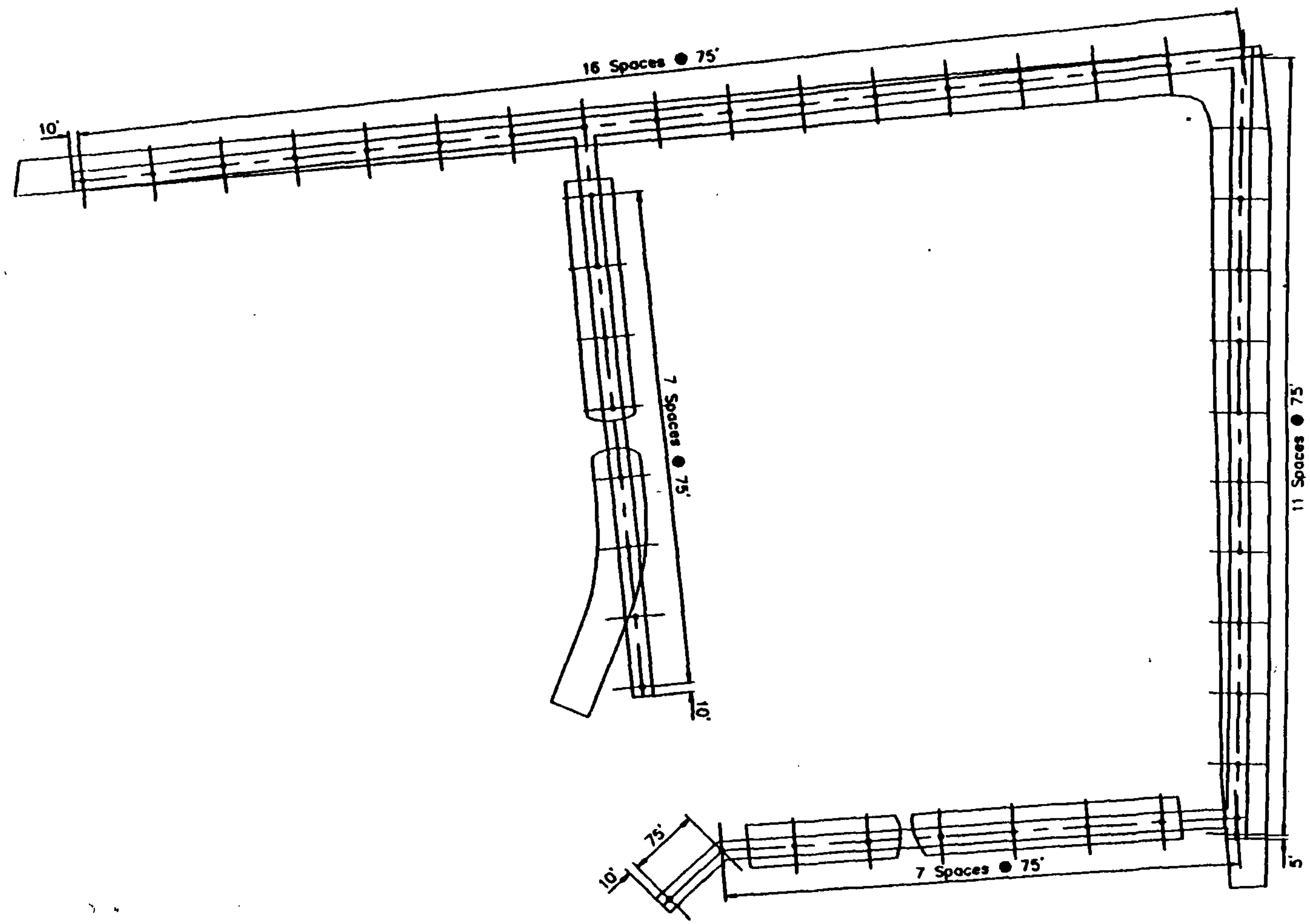
ENSR

ENSR CONSULTING & ENGINEERING

FIGURE 5 - 1
COOLING WATER CANAL BOUNDARIES

DRAWN BY:	DATE:	PROJECT NO.
K.P.B.	3/93	1100–004

110013A



LEGEND

• Former Soil Sample

0 120 240
SCALE IN FEET

N

ENSR
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FIGURE 5-2
COOLING WATER CANAL
FORMER SAMPLING GRID

DRAWN BY	DATE	PROJECT NO.
KLU	8/89	1100-001-10

D014B

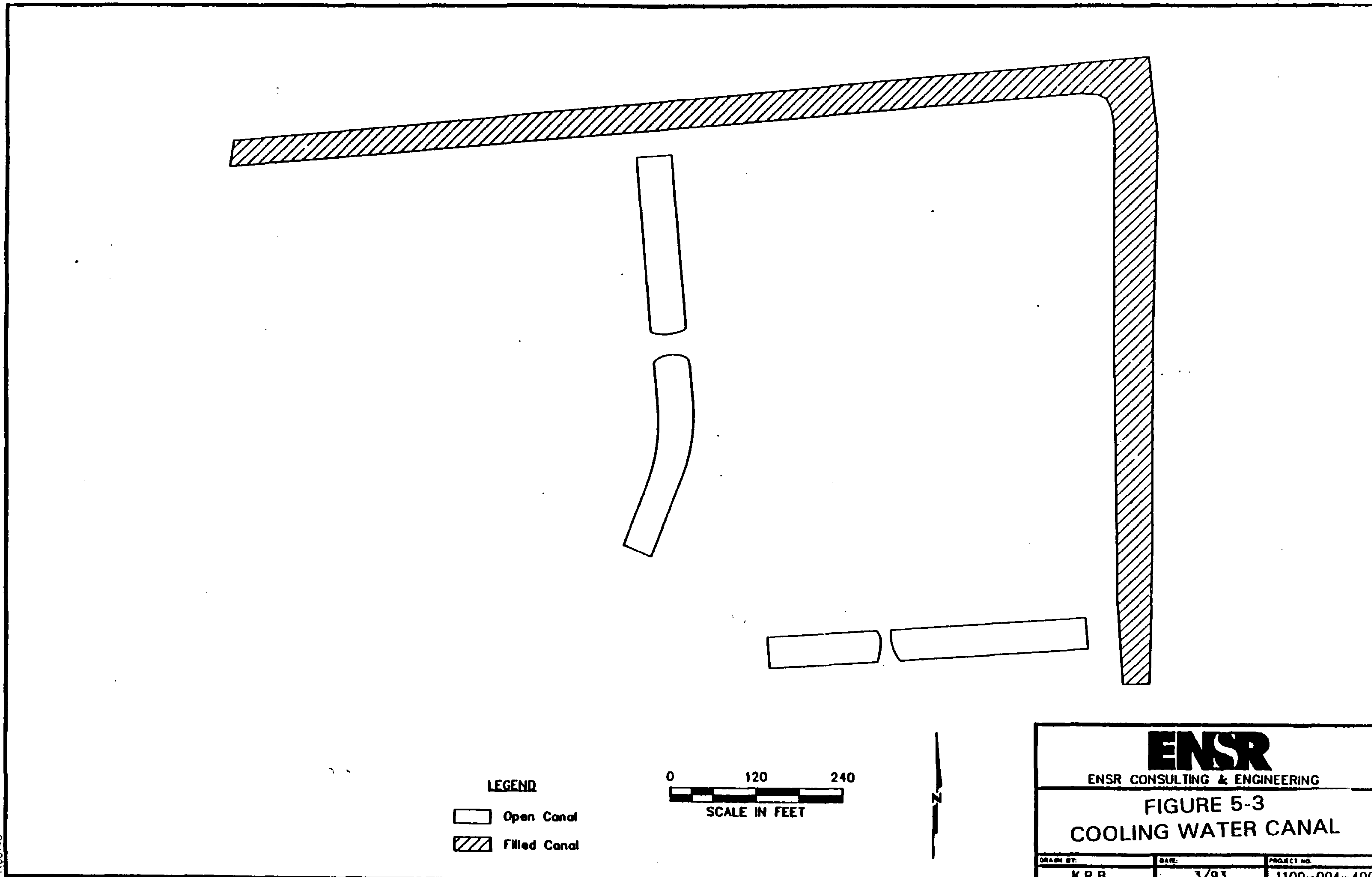

FIGURE 5-3
COOLING WATER CANAL

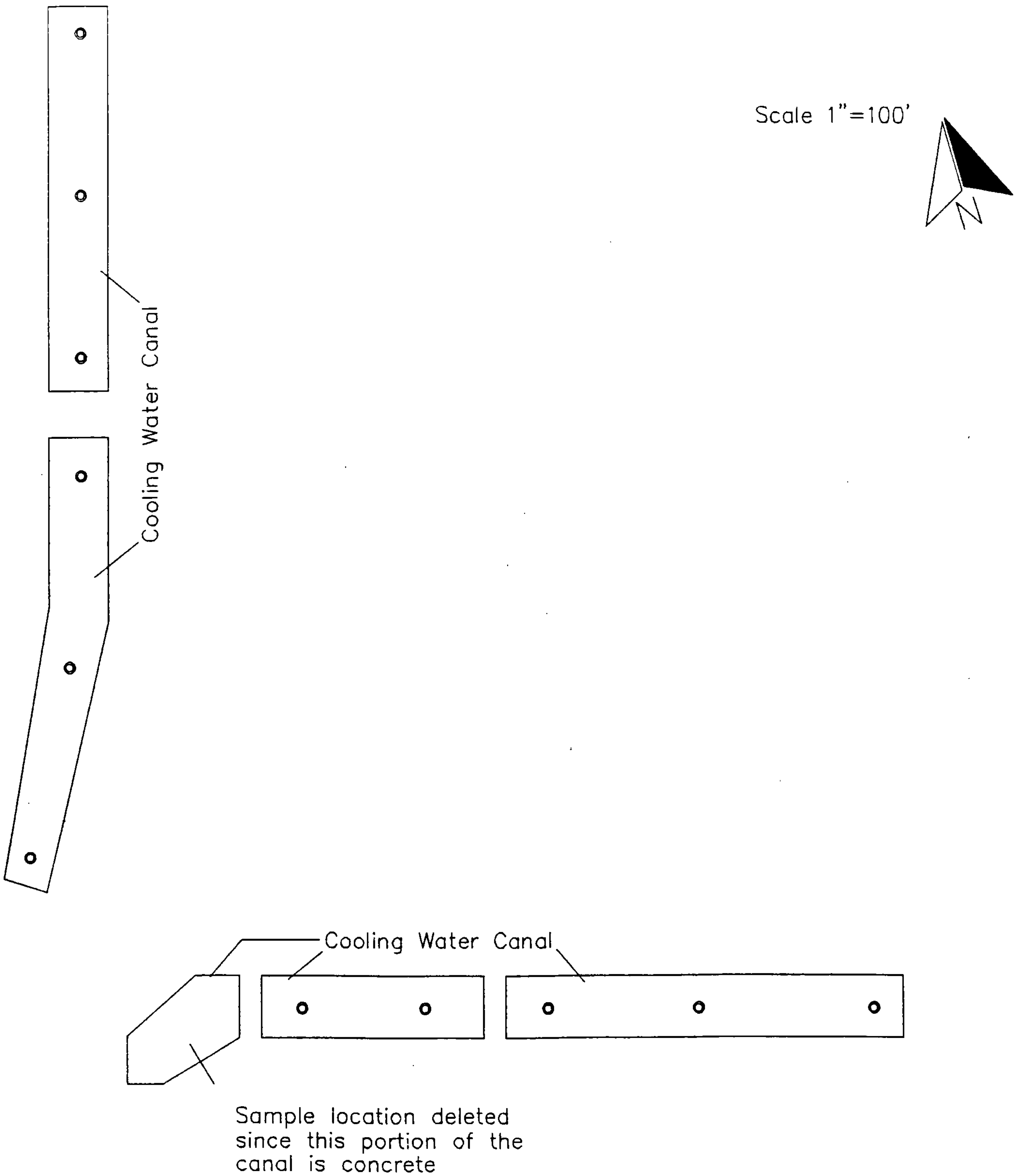

Figure 5-4
Chemetco Inc.
Soil Sampling Locations
Open Portion – Canals

CSD Environmental Services, Inc.

Chemetco Inc.
Figure 5-5
Closure Schedule for Cooling Water Canals

Activity	**Time**											
USEPA approval(order) of Zinc Oxide Bunker as a CAMU	0-30days	30-60	60-90	90-120	120-150	150-180	180-210	210-240	240-270	270-300	300-330	330-360
Dewater Open Portion of Canals and remove sediment												
Sample Bottom of Open Portion of Canals												
PE Certification												
Closure Certification Report												

1996 Sampling and Analysis Plan for the Zinc Oxide Lagoons and Cooling Water Canals
at
Chemetco, Inc.

CSD Environmental
Services, Inc.

FILE COPY

RCRA Closure

January 16, 1996

Illinois Environmental Protection Agency
Bureau of Land - Permit Section - #24
2200 Churchill Road, P.O.Box 19276
Springfield, IL 62794-9276

RE: 1198010003 - Madison County
Chemetco
RCRA Closure/Post Closure

Attn: Mr. Kevin Lesko

Dear Mr. Lesko:

Enclosed please find four copies of the sampling and analysis plan (SAP) for the zinc oxide lagoons & cooling water canals at Chemetco, Inc. This plan was discussed in our meeting of October 19, 1995. At that time, we discussed closing these two units in place with a modified RCRA cover.

The Agency asked for information as to the levels of cadmium and lead that would remain in the units. To address this concern, Chemetco proposes to complete the enclosed SAP and submit the results to the Agency for review.

We would appreciate your comments as to the ability of the SAP to provide the information you will need to approve a modified cover proposal.

Thank you in advance for your consideration.

Sincerely,

Harry A. Chappel, P.E.
Vice President

cc: Greg Cotter - Chemetco, Inc. (with enclosure)

1198010003--Madison County
Chemetco, Inc.
RCRA Permits
Soil Sampling and Analysis Plan For Former
Zinc Oxide Lagoons & Cooling Water Canals

Prepared by CSD Environmental Services, Inc.
2220 Yale Boulevard
Springfield, IL 62703
217/522-4085
Fax 217/522-4087

January 12, 1996

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CHEMETCO, INC.
SOIL SAMPLING AND ANALYSIS PLAN
FOR FORMER
ZINC OXIDE LAGOONS & COOLING WATER CANALS

1.0 INTRODUCTION

Chemetco, Inc. (Chemetco) is pursuing closure of the Zinc Oxide Lagoon (Lagoon) and Cooling Water Canals (Canals). Chemetco proposes to close these units in place without additional soil removal and with a modified cap (i.e., asphalt). Chemetco met with the Illinois Environmental Protection Agency (Agency) on October 19, 1995 to discuss the details of this proposal. At that time, the Agency requested additional information regarding the levels of lead and cadmium which would remain in these areas if this proposal were to be approved.

The purpose of this soil sampling and analysis plan is to establish the methodology to be used to determine the levels of lead and cadmium which are proposed to remain in these areas.

2.0 SAMPLING AND ANALYSIS

2.1 Objectives

This Sampling and Analysis Plan (SAP) describes the activities associated with determining location of, and collection method for, samples to determine the levels of lead and cadmium which are proposed to remain in the soil.

2.2 Sampling Team Responsibilities

Responsibilities of the sampling team are described below:

2.2.1 Sampling Team Leader

The sampling team leader (STL) will be responsible for conducting the sampling program, assuring the availability and maintenance of all sampling equipment and materials, and providing for shipping and packing materials. The STL will supervise and be responsible for the completion of all chain-of-custody records, proper handling and shipping of the samples collected, and the accurate completion of field log books. The STL will be present on-site whenever samples are collected.

2.2.2 Sampling Team Member(s)

The sampling team member(s) (STM) will collect samples, transfer them for shipping, and decontaminate sampling equipment as directed by the STL.

2.3 Sampling Summary

Soil samples will be collected from a grid interval and the sampling depths described in Section 3.2.

Soil samples will be analyzed using USEPA SW-846 methods for pH, total lead and cadmium. The total level of lead and cadmium found in each sample will be compared to the Class I groundwater quality standard for these constituents. The ten (10) samples which exceed either constituents Class I standards by twenty (20) times will be analyzed using the TCLP method for the constituents(s) in excess of this level. These analytical parameters were selected based on knowledge of the types of waste streams stored in these areas. This data will be evaluated in accordance with Section 4.0 of this plan.

3.0 SITE CHARACTERIZATION AND SAMPLING PROCEDURES

The following subsections present the procedures to be followed for site activities related to field surveys and sampling efforts.

3.1 Site Preparation for Soil Sampling

Prior to collecting soil samples from the cooling water canals and zinc oxide lagoons the following steps will be conducted to prepare the site:

- The slag located over the former lagoons will be relocated to a different area of the plant;

- The storm water currently stored in the open portion of the canals will be rerouted to either a tank or a new storm water detention pond to be constructed; and

- The copper fines currently in the bottom of the open portion of the canals will be removed by a backhoe and transported to the dust injection system. The fines accumulated in the storm water detention basin due to one of the storm water sumps being located near the copper fines building.

3.2 Soil Sampling Procedures

The location of the soil sampling points are to be based on the following grid:

1. ZnO Pit - Twelve (12) soil sample points were determined using a grid of 100' x 75'.

2. Lagoons - Twelve (12) sampling locations were determined using a spacing of approximately 110 feet between samples.

The proposed grid spacing is intended to provide sufficient samples to evaluate the use of an alternate cap while minimizing sample costs.

Samples will be collected from the bottom of the lagoon and canals at each of the sampling points. Figure 1 is a map of the approximate sample locations. The soil samples will be collected using either a hand auger or a 2 inch diameter, 2 foot length split spoon sampler. Samples will be collected at two intervals, 0-6 inches and 18 - 24 inches in depth.

The soil will be sampled using the following procedures:

1. A decontaminated backhoe will be used to push the slag liner of the canals to the side;

2. A decontaminated split spoon sampler will be pushed or driven to obtain a representative soil sample. If a hand auger is used the auger will be turned to the appropriate depth to obtain a representative sample;

3. The sample will be removed from the sample tube in the field and placed in a laboratory provided glass jar for shipping;

4. The sample jar will be immediately placed into a cooler chilled to 4 degrees Celsius; and

5. The samples will be transported to the laboratory within 24 hours of sample collection.

The split spoon or hand auger will be decontaminated in accordance with the procedures discussed in Section 3.8. The backhoe will be decontaminated prior to and upon completion of sampling in accordance with the procedures in Section 3.8.

3.3 Analytical Program

All soil samples sent for chemical analysis will be analyzed for the group of parameters specified in Section 2.3 by Environmental Analysis Inc. of Florissant, Missouri.

3.4 Drilling Methodologies

Before beginning to auger the site, the contractor will become acquainted with the site features and the planned boring locations. Any movable structures will be cleared away from each location, if necessary. Equipment will be decontaminated prior to each new soil boring, following procedures included in

Section 3.8.

3.5 Documentation

Sample collection will take place in the presence of a geologist. The geologist will log all borings and, at a minimum, will note the following:

- sample identification;
- date(s);
- sampling equipment used;
- sample depths;
- sample recovery;
- sample description; and
- remarks.

3.6 Sample Numbering System and Labeling

A sample numbering system will be used to allow tracking, retrieval, cross referencing of sample information and positive identification. Each sample submitted for chemical analysis will be assigned a unique sample identification number. The samples will be numbered as identified below.

For samples collected from the cooling canals the following number system shall be used:

CC 1 - 6"
CC 1 - 18"

CC will identify the sample as being derived from the cooling canals, with the numerical designation identifying the sample order of the canals; and finally the depth at which the sample was collected will be provided.

For samples collected from the zinc oxide lagoons the following number system shall be used:

ZL 1 - 6"
ZL 1 - 18"

ZL will identify the sample as being derived from the lagoons, with the numerical designation identifying the sample order of the canals, and the depth at which the sample was collected will be provided.

3.6.1 Labeling

Sample labels will be affixed to each sample at the time of collection. The label will include the following information as a minimum:

- Sample identification number;
- Date sampled;
- Time sampled; and
- Person sampling.

In addition, each person involved in the sampling activity will record the above information, as well as comments regarding sampling, in a field log book and on the chain of custody form.

3.7 Sample Shipment

Each sample will be placed into individual laboratory provided glass jars. Samples will be placed carefully in coolers for storage and shipment. At least two bags of ice, sealed in double plastic bags will be placed inside to maintain samples at approximately 4 degrees C. Each cooler will be provided with a chain-of-custody form. Attachment 1 illustrates a typical chain-of-custody form.

All environmental samples for analytical testing will be hand delivered to Environmental Analysis within 24 hours after sampling to allow completion of analyses within the specified holding times.

3.8 Decontamination Procedures

A variety of equipment will be used repeatedly during the course of the work for sampling purposes. In order to minimize the potential for cross-contamination between borings, samples and equipment which may come in contact with the sample media will be decontaminated before sampling. In addition, all equipment will be decontaminated between samples. All rinse waters used for decontamination will be captured and containerized into 55 gallon drums. The rinse waters will be transported to the polish pits for disposal.

Reusable non-dedicated equipment (hand auger, split spoons, scoops, etc.) will be decontaminated between each sample and before removal from the site. The decontamination procedures for all sampling equipment will be as follows:

1. Soap wash (Alconox or equivalent) in hot water solution;
2. Potable hot water rinse;
3. Methanol rinse;
4. Potable hot water rinse;
5. Distilled water rinse; and,
6. Air Dry.

The backhoe used to scrape the slag layer and to push the split spoons will be decontaminated prior to and immediately after completion of the project. The backhoe will be decontaminated using a high pressure hot water wash. A decontamination pad will be constructed of plastic sheeting and railroad ties. All rinse waters will be collected by a portable pump and transferred into 55 gallon drums. The rinse water will be transferred to the polish pits for disposal.

3.9 Miscellaneous

3.9.1 Quality Assurance/Quality Control

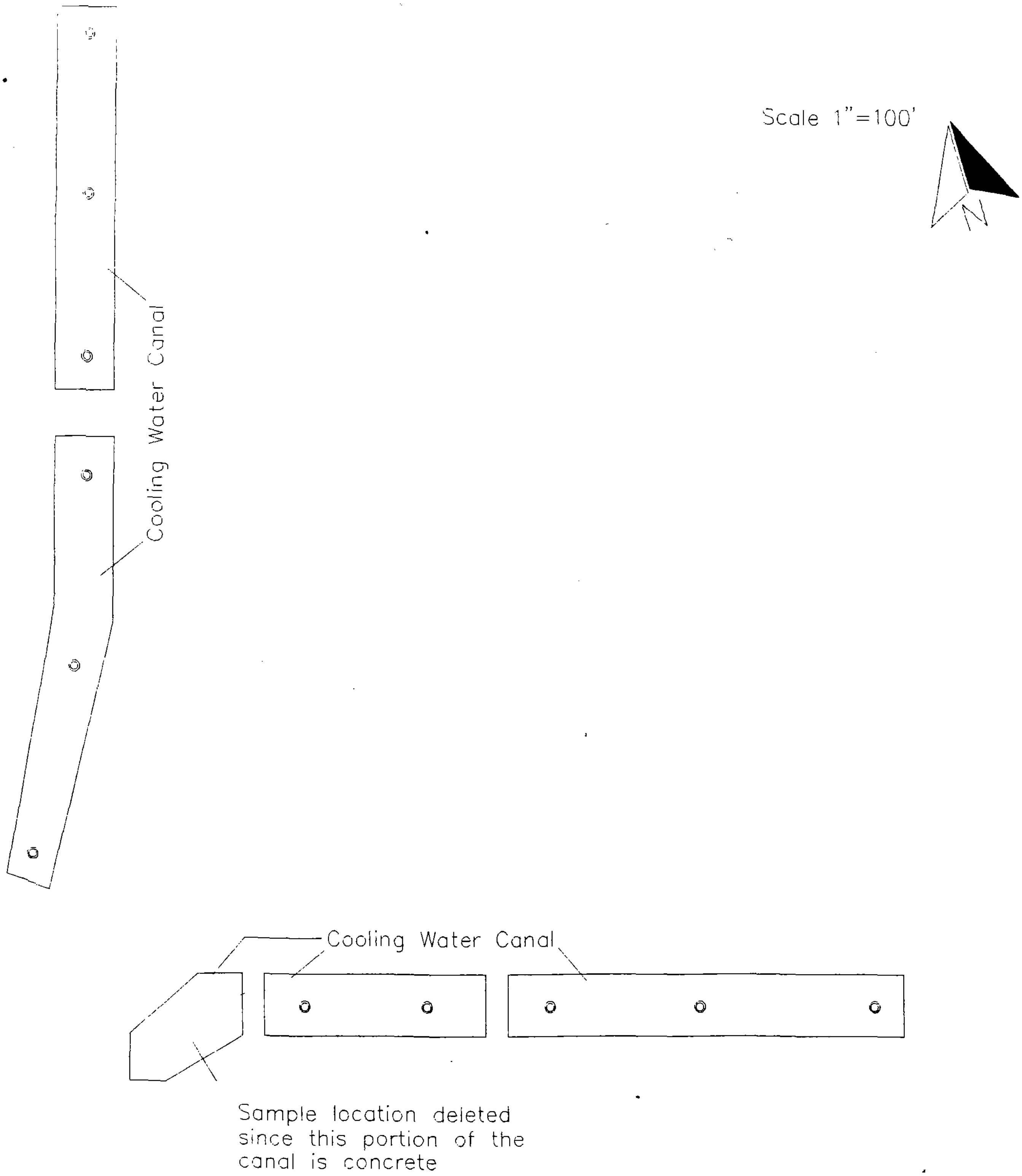

Figure 5-4
Chemetco Inc.
Soil Sampling Locations
Open Portion - Canals

CSD Environmental Services, Inc.

Quality Assurance/Quality Control samples will include a field blank. The field equipment rinse blank sample will be collected by pouring laboratory-provided distilled/deionized water over a decontaminated split spoon or hand auger. The field blank will be analyzed for the metals of concern.

4.0 SITE INVESTIGATION REPORT

Following receipt of final analytical results, a report will be prepared summarizing the methods and results of the investigation. The report will contain information as outlined below.

An area map will be prepared showing the general site location. Field and laboratory methods will be outlined and laboratory analytical results will be reported. The nature and extent of any subsurface contaminants detected during the investigation will be summarized.

The data will be evaluated to determine if waste constituents are present in the soil at a concentration which would require a RCRA type cap or possible modified cap (i.e. asphalt).

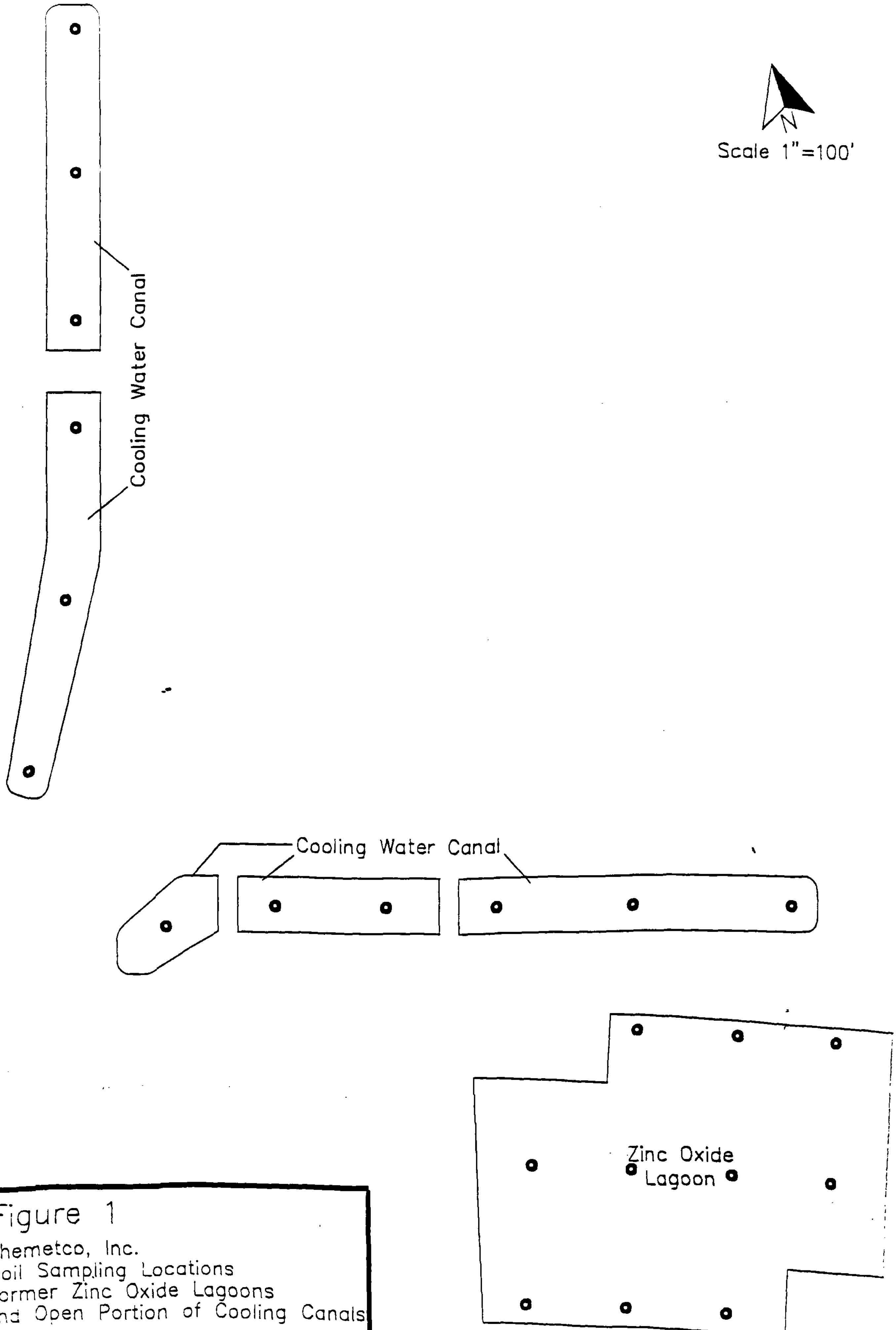

Figure 1

Chemetco, Inc.
Soil Sampling Locations
Former Zinc Oxide Lagoons
and Open Portion of Cooling Canals

o Approximate Sample Locations

Environmental Analysis, Inc.

3278 N. Lindbergh Blvd. · Florissant, MO 63033 · 314-921-4488

EAI

SAMPLE CHAIN-OF-CUSTODY RECORD

Client Name ______________________

Address ______________________

Contact ______________________

Telephone ( ) ______________________

Sample Identification ______________________

Date/Time Collected ______________________

Sample Type ______________________

Collected By (Signature) ______________________

Bottle	Preservative	Tests Requested

Total Bottles

LABORATORY RECORD

Lab #1 - Environmental Analysis, Inc.

Laboratory Log Number ______________________

Sample Received By (signature) ______________________ Date/Time ______________________

Analyses Performed	Analyzed By (signature)	Date/Time Analyzed	Analyses Performed	Analyzed By (signature)	Date/Time Analyzed

REPORT OF ANALYSIS

Lab #1: Report No. ______________________ Date: ______________________ Signature: ______________________

Title: ______________________

IEPA and CSD Responses' to Sampling and Analysis Plan for Zinc Oxide Lagoons and Cooling Water Canals

INTERIM STATUS CLOSURE AND CONTINGENT CLOSURE/POST CLOSURE PLANS FOR THE ZINC OXIDE BUNKER AT CHEMETCO, INC.

1198010003--Madison County
Hartford/Chemetco
RCRA Closure
ILD048843809

February 26, 1997

CSD
Environmental Services Inc.
2220 Yale Boulevard
Springfield, IL 62703
(217) 522-4085

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LIST OF TABLES, FIGURES AND APPENDICES

ZINC OXIDE BUNKER CLOSURE PLAN

1.0 Introduction

This document presents revised closure and contingent closure/post-closure plans for the zinc oxide bunker at Chemetco, Inc. ("Chemetco"), Hartford, Illinois. Chemetco is pursuing "clean closure" of the bunker. This revised closure plan describes the procedures for handling materials removed from the bunker. A contingent closure option (closure as a land disposal unit) is included in the plan for purposes of developing estimates of cost and establishing the required level of financial assurance for closure and post-closure under a "worst case" scenario.

Chemetco has contracts in place for the purchase of zinc oxide. Because the zinc oxide has been determined by the Illinois Environmental Protection Agency "IEPA" to have been accumulated speculatively, Chemetco has requested the Illinois Pollution Control Board determine that these materials are not solid wastes in accordance with 35 IAC, section 720.130 and 720.131 to allow sales to off-site customers. If this request is denied or in the event that Chemetco cannot achieve "clean closure" of the bunker through removal of all wastes and residues, a contingent closure/post-closure plan is provided for closure as an interim status landfill. Financial assurance will be provided for the contingent plan.

This document is submitted on behalf of the request of the IEPA during a meeting with Chemetco, IEPA, and the Illinois Attorney General's Office on February 13, 1997. This plan was developed in accordance with the IEPA's "Guidance for Preparing Closure Plans for Interim Status RCRA Hazardous Waste Facilities, November 1994."

2.0 Facility Description

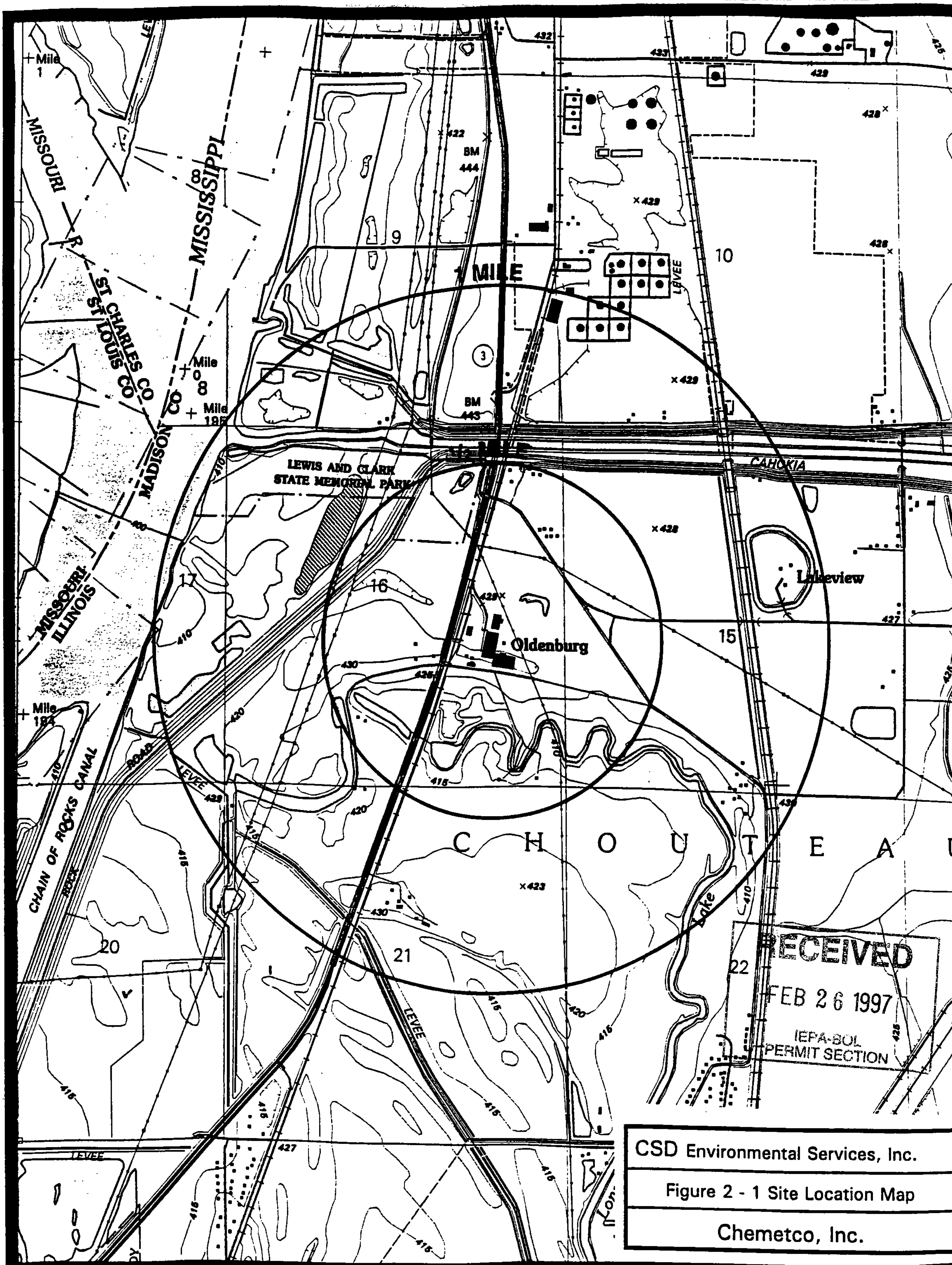
The Chemetco facility was constructed in 1969 and commenced production of anode copper, cathode copper, crude lead-tin solder, zinc oxide and slag in 1970. The Chemetco facility is located within a primarily agricultural, light residential area south of Hartford and is bounded on the west by major, heavily traveled rail and highway routes and on the south by a limited use secondary road. More specifically, the 200+ acre plant site is in the Southeast 1/4, Section 16, Township 4 North, Range 9 West of the Third Principal Meridian, in Madison County (see Figure 2-1). Chemetco's most recent Part A submission listed storage in a waste pile (S03) and three (3) surface impoundments (D83) as the waste management practices on site (see Figure 2-2). This modified Part A application, which embodies agreements reached between Chemetco and IEPA, was submitted with the March 1993 RCRA Part B Post-Closure Application. The Part A lists the following waste management practices:

- storage in a waste pile, S03, includes the zinc oxide bunker and former zinc oxide pile; and

- storage in a surface impoundment, D83, includes the floor wash water impoundment, zinc oxide lagoons and cooling water canal.

2.1 Facility Address And Identification Numbers

Chemetco, Inc.
Route 3
Hartford, IL
IEPA #1198010003
USEPA # ILD048843809



CSD Environmental Services, Inc.
Figure 2 - 1 Site Location Map
Chemetco, Inc.

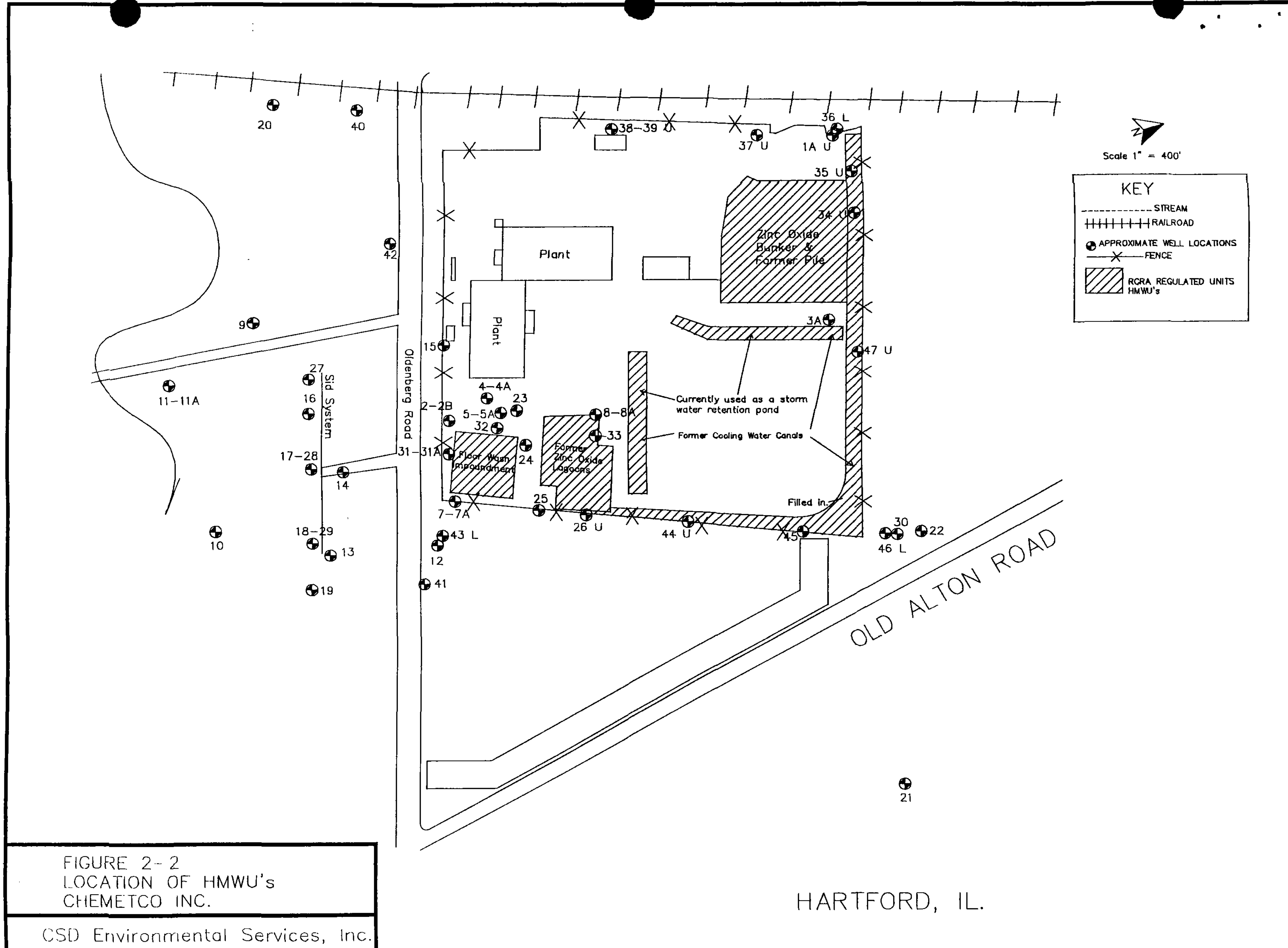


FIGURE 2-2
LOCATION OF HMWU's
CHEMETCO INC.

CSD Environmental Services, Inc.

2.2 Waste Management Unit Being Closed

The zinc oxide bunker is listed on page 1, line 1 of the facility's revised Part A, Form 3. The unit, which is approximately 365 feet by 310 feet in dimension, has an estimated capacity of 3,000,000 gallons. The bunker was constructed in phases in 1984 to replace an on-ground zinc oxide pile of approximate dimensions 150 feet by 200 feet. The former pile was located on the same site as the current bunker. The bunker primarily contains approximately 40,000 tons of zinc oxide with lesser amounts of soil excavated during the closure of the former pile, zinc oxide lagoons and cooling canal, and a significant amount of slag (23,500 tons) used as a wind dispersal control measure on the north and west sides. Testing has shown the zinc oxide, which is being sold for reclamation of pure metals, to be extraction procedure toxic for lead.

2.3 Overview of Closure Approach

Under the closure and post-closure standards for waste piles, 40 CFR 265 Subpart L and 35 Ill. Adm. Code Subtitle G, Part 725 Subpart L, Chemetco intends to "clean close" the zinc oxide bunker, with all waste residues and contaminated materials removed or decontaminated so that no post-closure monitoring will be required for this unit.

The former zinc oxide pile was decommissioned previously by Chemetco and the zinc oxide bunker created in its place. The former (closed) zinc oxide pile will be closed in its "as is" state and be subject to post closure monitoring using the existing groundwater monitoring well system.

This closure plan summarizes the activities completed to date at the former pile and details the closure to be implemented for the existing zinc oxide bunker.

2.4 Summary of Activities Completed to Date

A 150-foot by 200-foot zinc oxide pile was used to store and dry zinc oxide from the zinc oxide lagoons. Containment was provided by a low permeability berm and underlying clay that prevented runoff and infiltration, respectively. Closure of the pile began in early 1984 with removal of the stored material and excavation of the underlying soils. Zinc oxide material was moved from the north end of the storage area to the concreted areas to the west with both a crawler-loader and a rubber-tired front end loader. After all the zinc oxide was removed from the north end, the underlying soil was excavated until visibly clean. All excavated soil was placed with the zinc oxide material on the concrete surface to the west. A sampling grid was laid out at 50- by 75-foot intervals to provide samples for E.P. Toxicity testing for lead and cadmium. Excavation continued until satisfactory results were obtained. After achieving lead and cadmium levels below the detection limits of these analyses, the north section was covered by an 8-inch reinforced concrete slab and containment wall. The process of excavation, sampling, and concrete construction was repeated for the south section of the pile, as described in detail in the 1986 Closure Documentation Report. After the southern slab was poured and cured, the zinc oxide material and the excavated soil were moved by a rubber-tired front-end loader from temporary storage on the concrete west of the old site, to the new storage bunker. The southern walls were constructed. Also a secondary containment system, consisting of a concrete curb and sump, was constructed around the perimeter of the bunker walls. The final analyses which document the clean closure of the former pile are summarized in Table 2-1. Copies of the laboratory reports are included as Appendix 1. Results of an Appendix IX analyses of the zinc oxide are provided in Appendix 2. Sampling locations are provided in Figure 2-3.

3.0 Waste Inventory

The zinc oxide bunker presently contains approximately 40,000 tons of zinc oxide and soils excavated from the former zinc oxide pile, the zinc oxide lagoons and the cooling water canal during closure and 23,500 tons of slag. No zinc oxide produced in daily plant operations is presently stored in the bunker. No zinc oxide or other materials have been added to the bunker since the cooling water canal was closed in September 1985.

4.0 Closure Procedure

The following subsections describe the procedures that will be followed in closing the zinc oxide bunker.

4.1 Removal of Zinc Oxide

Zinc oxide material is to be removed from the bunker by slurrying and pumping from the bottom of the bunker. The slag layer is to remain in tact during the removal process to the extent possible. The slag layer will be relatively undisturbed as the zinc oxide beneath the layer is reduced. If necessary to facilitate removal of the zinc oxide, the slag layer may be peeled back from a portion of the zinc oxide to allow heavy

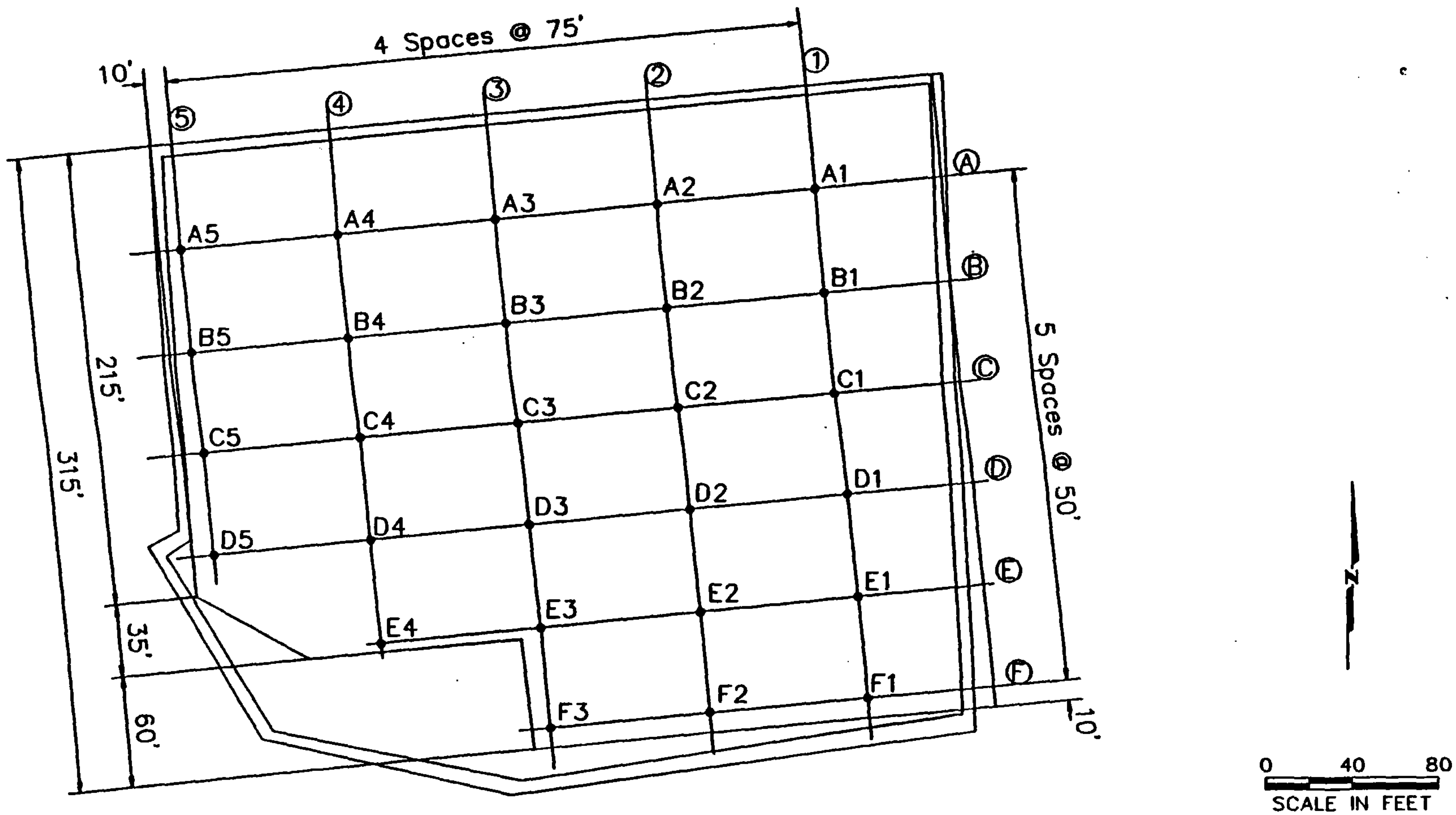
TABLE 2-1
SUMMARY OF EP TOXICITY TEST RESULTS
FORMER ZINC OXIDE PILE

Sample Number	Lead mg/l	Cadmium mg/l	Lab
A1	BDL	BDL	ERT
A2	BDL	BDL	ERT
A3	BDL	BDL	ERT
A4	BDL	BDL	ERT
A5	BDL	BDL	ERT
B1	BDL	BDL	ERT
B2	BDL	BDL	ERT
B3	BDL	BDL	ERT
B4	BDL	BDL	ERT
B5	BDL	BDL	ERT
C1	BDL	BDL	ERT
C2	BDL	BDL	ERT
C3	BDL	BDL	ERT
C4	BDL	BDL	ERT
C5	BDL	BDL	ERT
D1	BDL	BDL	ERT
D2	BDL	BDL	ERT
D3	BDL	BDL	ERT
D4	BDL	BDL	ERT
D5	BDL	BDL	ERT
E1	BDL	BDL	ERT
E2	BDL	BDL	ERT
E3	BDL	BDL	ERT
E4	BDL	BDL	ERT
F1	BDL	BDL	ERT
F2	BDL	BDL	ERT
F3	BDL	BDL	ERT

Detection Limit: 0.05 mg/l Analytical Method SW846 6010

Prepared by CSD Environmental Services, Inc., February 1997

110011A



LEGEND

• Former Soil Sample

CSD Environmental Services, Inc.

FIGURE: 2-3
Zinc Oxide Bunker
Former Sampling Grid

Chemetco, Inc.

equipment to push the zinc oxide towards the pump. The peeled portion of the slag will remain in the bunker, unless it can be demonstrated by a visual inspection the slag is not contaminated with zinc oxide. The wet material will be slurried in the bunker sump and pumped from the bunker. Screens will be installed in the bunker sump and in front of the pump itself to protect from large solids. The pump will be a Lawrence 8-inch ReFax with a capacity of 2,250 gallons per minute. A flow meter will be installed to monitor the volume of zinc oxide being removed from the bunker. A valve will be installed prior to the pump to control the flow of zinc oxide. Water for the slurrying operation will be provided from either one or a combination of three sources, the existing facility water system (non-potable water from an on-site well); storm water currently contained in the storm water ponds; or recycled bunker water. The slurry (approximately 70% water) will be pumped to the existing AAF scrubber ponds also known as the "settling ponds". The zinc oxide slurry will be pumped from the ponds to the former tank house cells for initial dewatering and then to the presses for final dewatering and creation of a zinc oxide cake. The zinc oxide cake will be trucked to the fines building where it will be mixed with 50% copper and tin fines. The blended material is then transported to barges at the Phoenix terminal in Hartford and barged either to New Orleans or Chicago where the zinc oxide is clamshelled from the barges and loaded into a ship for transportation to overseas customers. Refer to Figure 4-1 for a flow diagram of the zinc oxide handling. The material will not be considered to be a solid waste if the requested determination from the Illinois Pollution Control Board is received. The closure period under this option is expected to be 1 to 5 years.

4.2 Removal of Slag

Because of the method used in filling the zinc oxide bunker and the use of slag

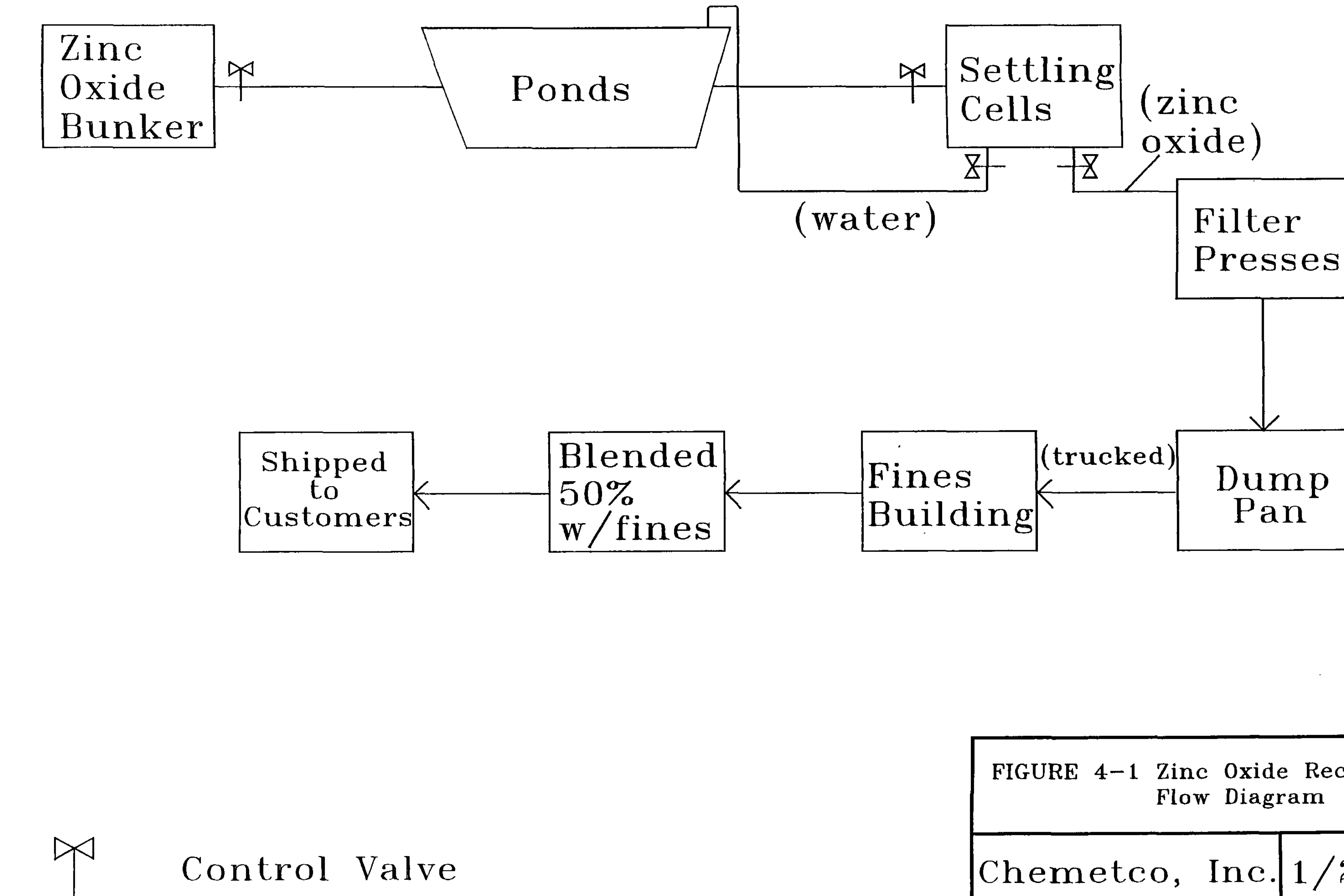


FIGURE 4-1 Zinc Oxide Recycling Flow Diagram

Chemetco, Inc.	1/24/97

CSD Environmental Services, Inc.

as a wind-dispersal control agent, zinc oxide in the bunker is intermixed with slag. It is estimated the zinc oxide bunker contains approximately 23,500 tons of slag. Chemetco intends to remove and segregate the slag materials from the zinc oxide. These materials are readily discernable to physical segregation, by means of visual inspection, and by the inherently different physical properties of each of these materials themselves, i.e., the slag is a hardened, coarse, asphaltic-like material while the zinc oxide is primarily in a slurried ("wet") form. To ensure proper "decontamination" of the slag materials due to contact with the zinc oxide materials stored beneath the slag, a high pressure wash will be utilized to remove any incidental zinc oxide from the slag prior to removal from the bunker. The slag will be removed from the bunker with heavy equipment and combined with the slag currently generated.

4.3 Decontamination of Bunker

After the contents of the bunker and all visible contamination are removed, the concrete surface will be decontaminated. A visual inspection of the bunker will be conducted and photographs taken of the surface. Any residue adhering to the surface will be removed by scraping and/or brushing. The surface will then be pressure washed. All water will be captured by the sump and treated as described in Section 4.5. Any residual zinc oxide scraped from the bunker walls will be handled in the same manner as the zinc oxide removed from the bunker as detailed in Section 4.1.

4.4 Decontamination of Equipment

All mobile equipment will be dedicated to moving the material, as required, for the duration of the project. This also applies to any pumps and screening apparatus, that are used. At the end of this project all equipment will be decontaminated before being used in other plant operations.

Prior to leaving the bunker, any heavy mobile equipment that will no longer be needed will be scraped and washed with high pressure water until visibly clean. The rest of the equipment will be decontaminated in the same manner; all water will be captured by the sump and treated as described in Section 4.5. Any residual zinc oxide scraped from the bunker walls will be handled in the same manner as the zinc oxide removed from the bunker as detailed in Section 4.1.

4.5 Water Disposal

No water will require disposal until all of the zinc oxide is removed from the bunker. The residual water will be collected and used in the existing settling ponds system.

4.6 Bunker Integrity Inspection

An evaluation of the structural integrity of the bunker will be made to ensure that the bunker has indeed been able to operate as designed and constructed. The evaluation will determine if there has been a release of hazardous waste from the bunker to the environment. After removal of the zinc oxide and cleaning of the concrete an independent registered professional engineer will inspect the integrity of the surface. The surface will be inspected for cracks which penetrate through the concrete. In addition, all construction joints will be inspected to ensure they are watertight. The goal of the inspection will be to determine if cracks, joints, etc. are present in the base of the bunker which would allow any released waste to migrate through the base and into the underlying soil. The inspection will be carried out in accordance with the standards and recommendations of the professional/technical entities such as the American Concrete Institute, the Portland Cement Association, the American Society of Civil Engineers etc. relating to the ability of concrete structures to contain liquids. The results of this inspection will be submitted in an integrity inspection report within the closure documentation report. The integrity inspection report will include the results of the inspection, scaled drawings showing the location of all cracks and construction joints observed during the investigation; conclusions reached regarding any cracks or construction joints observed during the investigation; conclusions reached regarding any cracks or construction joints observed in the areas of concern; justification for the conclusion reached; photographs to support the conclusions; and certification by an independent registered engineer in accordance with 35 Ill. Adm. Code 702.126.

The bunker overlies a former hazardous waste management unit, the "zinc oxide pile". The zinc oxide pile will be closed in it's "as is" state and post-closure groundwater monitoring will be conducted. Any releases from the zinc oxide bunker may not be discernable from the former zinc oxide pile, therefore, Chemetco does not propose to conduct any soil sampling if it is determined that cracks, joints, etc. present in the concrete surface have the potential of allowing any released waste to migrate through the base into the underlying soil.

5.0 Post-Closure Provisions for the Bunker

landfill cap and the components of this cover are described below:

- The surface to the east of the existing bunker will be prepared for acceptance of some of the zinc oxide and slag presently in the bunker. This area will include a portion of one of the legs of the canal;

- Mechanical equipment will be utilized to move a portion of the present bunker contents and level the top surface of the remaining contents prior to construction of the impermeable cap;

- A 12-inch leveling course of fine slag over the material in the bunker to act as a buffer between the material and the geomembrane;

- A 30-mil thick geomembrane to limit infiltration while accommodating settling and subsidence;

- A geotextile layer to protect the geomembrane from abrasion by overlying drainage material;

- A 12-inch thick drainage layer to conduct infiltration off of the geomembrane and act as a protective buffer for the geomembrane. This layer will consist of coarse sand having a minimum saturated hydraulic conductivity of 1 x 10^{-3} cm/sec;

- A geotextile layer to prevent clogging of the drainage layer from soil fines;

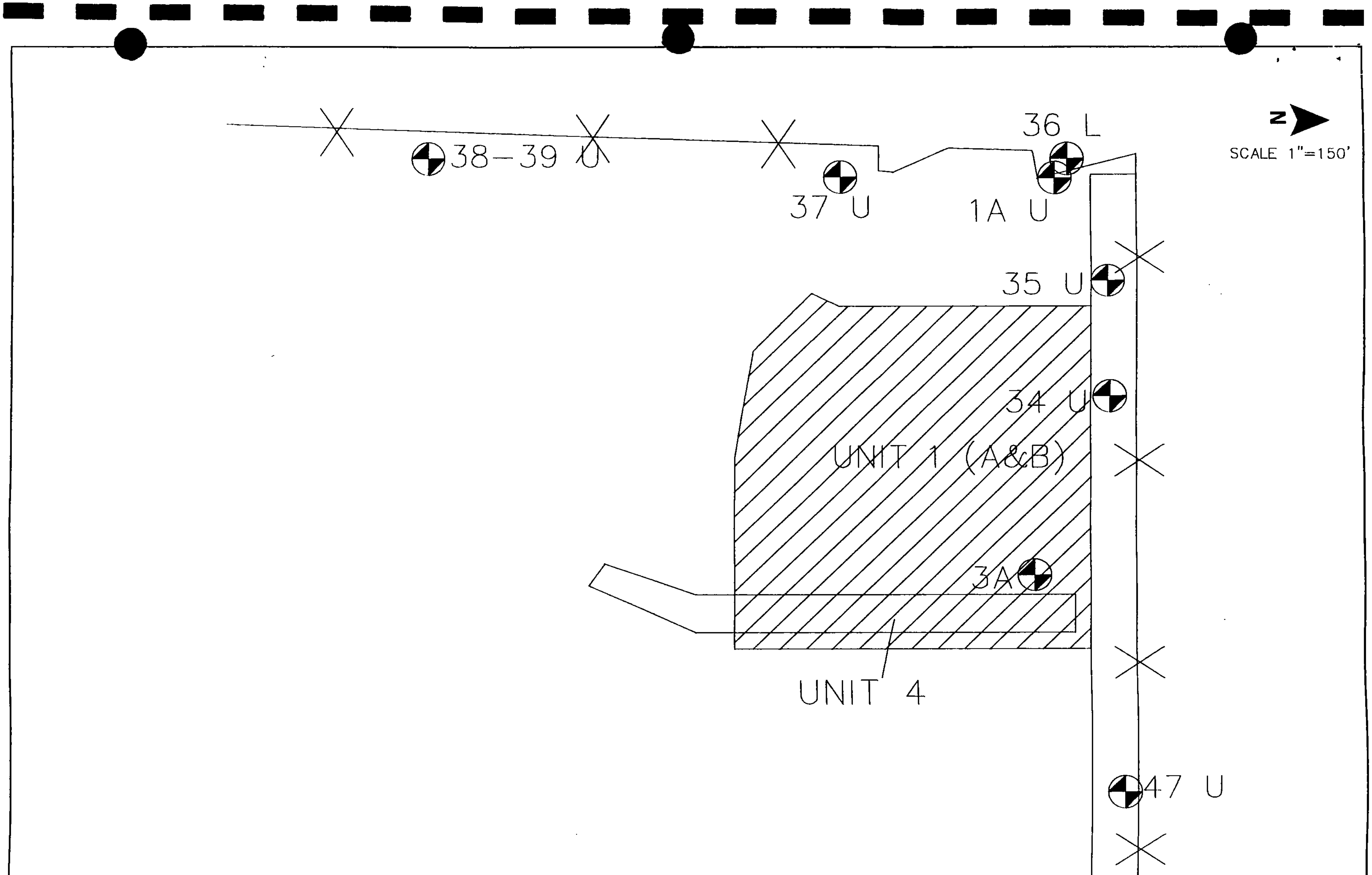


Figure 7-1

Zinc Oxide Bunker Cover System Location

CSD Environmental Services, Inc.

- An 18-inch thick fill layer to provide soil moisture retention and to buffer the underlying layers from root and rodent penetration;

- A 6-inch thick soil layer to support hardy shallow-root vegetation and

- Seed and mulch to establish vegetation.

The cover system will be installed on the area shown in Figure 7-1. Material specifications and placement procedures were provided in Appendix 3. The quality assurance testing program is also provided in Appendix 3. The area will be graded to establish top slopes of between 3 and 5 percent, which will promote runoff and prevent ponding. The vegetative cover will consist of a grass with a shallow root system which will act to minimize soil erosion. The existing fence surrounding the facility will prevent unauthorized access and disturbance of the cover system (which will be constructed after plant shutdown) in the event the closure plan to transport the zinc oxide off-site as a product fail.

Chemetco will prepare detailed engineering specifications and drawings for this cover system if the primary closure plan fails and IEPA has given approval of these contingent closure plans. The detailed specifications will be based on a survey to establish the limits of the cover system and the existing grades. Surveying will be performed with respect to permanent benchmarks by a professional land surveyor. Specifications and drawings will be sealed and signed by a professional engineer registered in the State of Illinois. The detailed specifications will be submitted for IEPA approval, as an addendum to these closure plans, within ninety (90) days of Chemetco's decision and IEPA's approval to implement this contingent plan.

8.0 Post-Closure Care

Post-closure care will begin after completion of the closure certification and will continue for thirty (30) years, unless the care period is shortened or extended by IEPA. Post-closure care will consist of groundwater monitoring as described in Section 3 of Chemetco's DRAFT Interim Status Revised Closure and Post Closure Plans dated June 1994 prepared by CSD Environmental Services, Inc. A revision to this plan will be submitted to the IEPA 90 days after the new monitoring wells are installed and background data has been collected. The new wells will be installed in 1997.

The facility contact during the post-closure care period is:

Mr. Greg Cotter, Environmental Manager
Chemetco, Inc.
P.O. Box 67
Hartford, Illinois 62048
(618) 254-4381

9.0 Certifications and Notices

During the closure activity and post-closure care, an independent, registered professional engineer will conduct periodic inspections to ensure that all critical activities are completed adequately and in accordance with the approved Closure (or Contingent Closure) and Post-Closure Plans.

Within sixty (60) days of completion of closure, Chemetco will submit by registered mail to the Administrator of USEPA Region V and the Director of the IEPA certification by Chemetco and an independent professional engineer registered in the State of Illinois that the facility has been closed in accordance with the approved closure plan. Likewise, within sixty (60) days of completion of post-closure care, certification will be submitted that the approved post-closure plan was followed. The certification will be signed by a responsible corporate officer, or duly authorized representative, and will contain the certification statement required under 35 Ill. Adm. Code Subtitle G, Section 702.126.

Chemetco will submit a survey plat at the time of closure certification to the IEPA, the local zoning authority and the Madison County Recorders Office if the contingent closure plan is implemented. The plat will indicate the location of the bunker with respect to permanently surveyed benchmarks, will note that the area's future use is restricted, and will be prepared and certified by a professional land surveyor. Within sixty (60) days of closure certification, Chemetco will submit a record of types, amounts, and location of waste materials or residuals in the bunker to the IEPA, the local zoning authority, and the Madison County Recorders Office. Within sixty (60) days of closure certification, Chemetco will also record a notation on the property deed and submit certification that such a notation has been made in accordance with 35 Ill. Adm. Code 724, Subpart G. This notation will alert any potential purchaser of the property that the land has been used to manage hazardous waste and its future use is restricted to a shallow-rooted grassland or non-residential or commercial development (i.e., parking area).

Within sixty (60) days of completion of the post-closure care period, Chemetco will submit to the Agency, by registered mail, a certification, signed by a responsible corporate officer, or duly authorized representative, and an independent registered professional engineer, that the activities during the post-closure care period were performed in accordance with the specifications in the approved post-closure plan.

10.0 Closure Schedule

Chemetco proposes to close the existing zinc oxide bunker in accordance with the schedule outlined in Figure 10-1. If implementation of the contingent closure plan is necessary, the schedule provided in Figure 10-2 will be followed. Should events beyond the control of Chemetco occur, an amendment to the closure schedule(s) will be submitted for Agency approval.

11.0 Closure Cost Estimate

The closure costs presented here are based on equipment and analytical services vendor quotes and the Means Cost Data for Site Work and Building Construction 1989 edition (1994 edition for contingent closure costs for bunker) and adjusted for inflation. Total closure cost for this unit is $32,554. Labor and operation and maintenance costs are incorporated in the cost for removing the bunker contents. The contingent closure cost for the zinc oxide bunker is estimated at $474,087. Chemetco is proposing, for financial assurance purposes, to provide financial assurance for the contingent closure. The total amount Chemetco will provide for closure for the bunker is $474,087 (contingent closure cost). Tables 11-1 and 11-2 summarize the costs.

12.0 Post-closure Cost Estimate

Contingent post-closure costs were estimated for zinc oxide bunker based on vendor quotes and the Means Building Construction Cost Data manual. The contingent annual post closure cost is estimated at $12,200. Table 12-1 summarizes the costs.

TABLE 11-1
CLOSURE COST ESTIMATE
CHEMETCO, INC.

ACTIVITY	UNIT	QUANTITY	UNIT COST[1]	TOTAL COST[2]
ZINC OXIDE BUNKER				
Decontamination of Unit				
Remove ZnO contents form bunker using pump, assuming 4,500 cy/day	DAY	14	750	10,500
Open bunker wall to allow equipment access 8" reinforced concrete	SF	200	8.86	1,772
Scrape and sweep bunker to remove residue (Chemetco equipment)	DAY	2	500	1,000
High Pressure wash to clean bunker (Chemetco equipment)	HOUR	3	500	1,500
Analyze rinsate samples metals (Pb and Cd)	SAMPLE	3	500	1,500
Soil Sampling & Analysis (App IX)	SAMPLE	8	1000	8,000
PE Certification	HR	24	80	1,920
Subtotal				**25,042**
20% Contingency				**5,008**
10% Administration				**2,504**
TOTAL				**32,554**

TABLE 11-2

CONTINGENT CLOSURE COST ESTIMATE
CHEMETCO, INC.

ACTIVITY	UNIT	QUANTITY	UNIT COST	TOTAL COST
ZINC OXIDE BUNKER				
Rework and grade material	CY	5,400	4.00	21,600
Place and compact slag	CY	5,400	4.00	21,600
Place and seam membrane	SY	16,100	5.70	91,770
Place and seam fabric	SY	16,100	1.56	25,116
Place and compact sand	CY	5,400	8.00	43,200
Place and seam fabric	SY	16,100	1.56	25,116
Place and compact fill	CY	8,100	8.00	64,800
Place and compact topsoil	CY	2,700	12.0	32,400
Hydroseed and mulch	SY	48,000	0.39	18,720
Engineering Oversight	HR	200	85.00	17,000
PE Certification	HR	24	140.00	3,360
Subtotal				**364,682**
20% Contingency				**72,937**
10% Administration				**36,468**
TOTAL				**$474,087**

**TABLE 12-1
CONTINGENT - POST CLOSURE COSTS
ZINC OXIDE BUNKER**

ACTIVITY	UNIT	QUANTITY	UNIT COST	TOTAL COST
ZINC OXIDE BUNKER				
Cover inspection and weeding	SY	16,000	0.22	3,520
Cover repairs (fill and seed)	SY	800	7.35	5,880
Subtotal				**9,400**
20% Contingency				**1,880**
10% Administration				**940**
TOTAL				**$12,220**

13.0 Personnel Safety and Fire Protection

Chemetco has requested the Illinois Pollution Control Board determine the materials within the bunker are not solid waste in accordance with 35 I.A.C. Section 720.130 and 720.131. If approved by the Board, the materials in the bunker will be technically considered waste as long as they are contained in the bunker, the material will be considered a product at the point it leaves the bunker through the sump. In accordance with the 29 CFR 1910, any cleanup conducted within the bunker will comply with the applicable requirements of OSHA's Hazardous Waste Operations and Emergency Response Standard. These requirements include hazard communication, medical surveillance, health and safety programs, air monitoring, decontamination and training. Prior to initiating clean up activities a site health and safety plan will be prepared to address all hazards of the area. All personnel working within the bunker will receive 40 hours of Health & Safety Training off-site plus a minimum of three days of actual field experience under the direct supervision of a trained experienced supervisor. All managers and supervisors at the clean up site will have at least eight additional hours of specialized training on managing hazardous waste operations.

FIGURE 10-1
CLOSURE SCHEDULE FOR ZINC OXIDE BUNKER

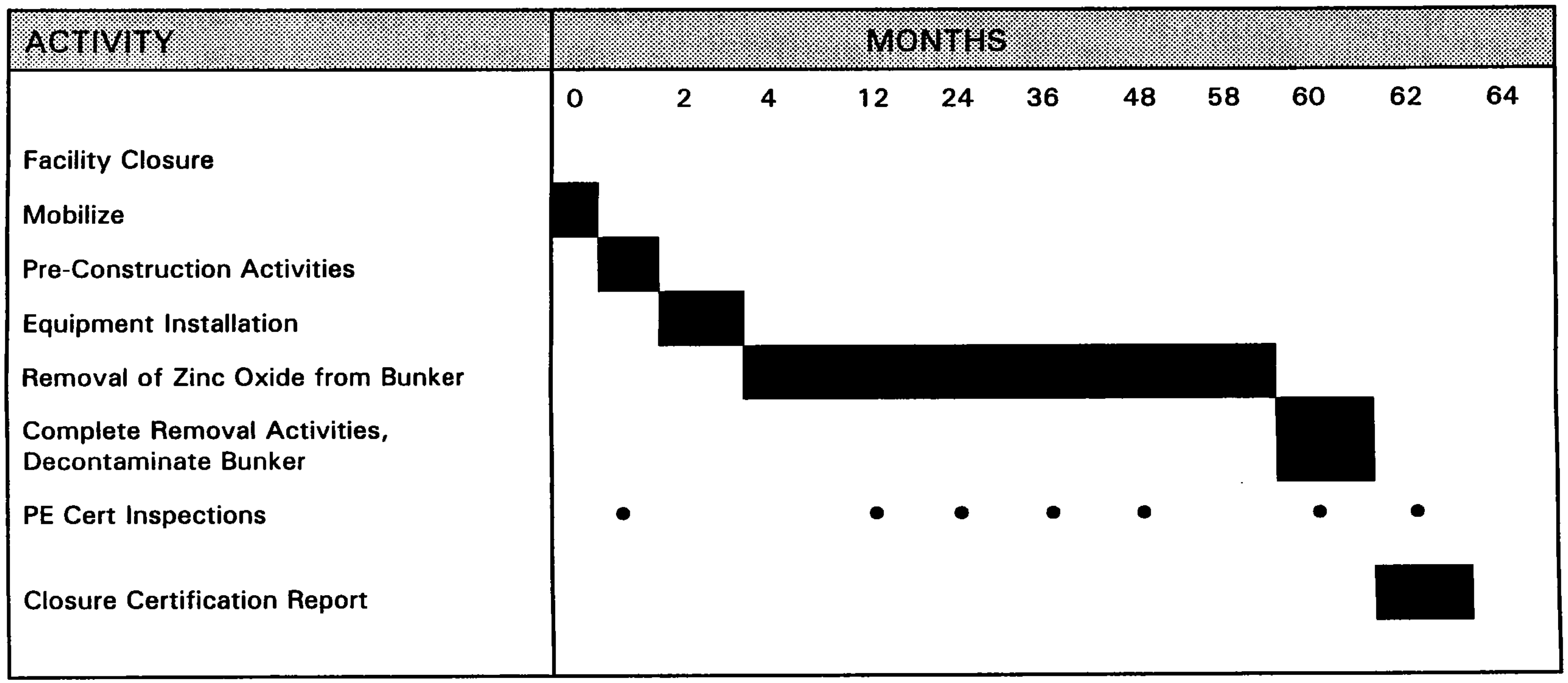
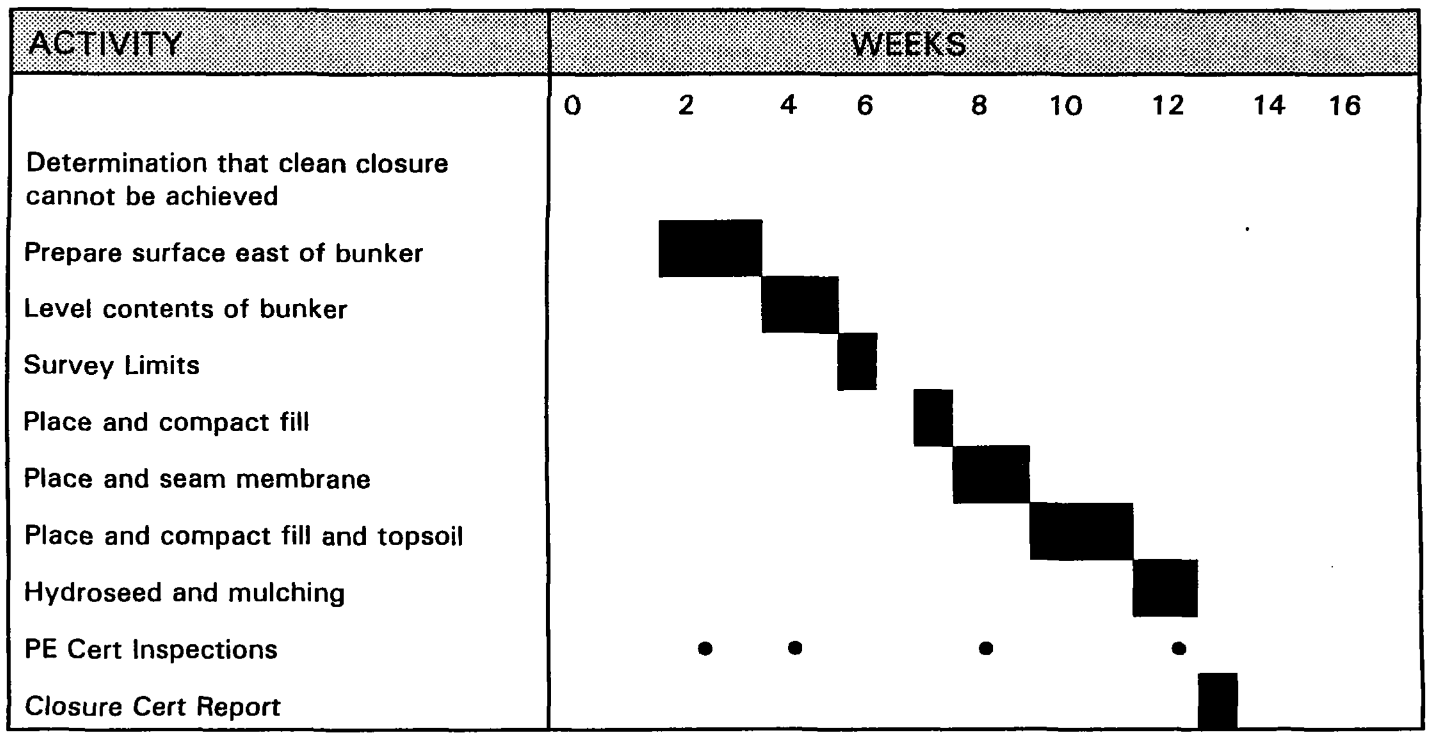


FIGURE 10-2
CONTINGENT CLOSURE SCHEDULE FOR ZINC OXIDE BUNKER



Appendix 1: Lab Results Zinc Oxide Pile

ANALYSIS OF SOIL SAMPLES
FROM CHEMETCO, INC.
ALTON, IL

ERT Project No. 0005-255
December 18, 1986

Prepared for

J. Lennon
ERT, A Resource Engineering Company
Concord, MA 01742

Prepared by

ERT, A Resource Engineering Company
696 Virginia Road, Concord, Massachusetts 01742

ANALYSIS OF SOIL SAMPLES
FROM CHEMETCO, INC.
ALTON, IL

INTRODUCTION

This report represents the results of analysis conducted on various soil samples received by the ERT Analytical Chemistry Laboratory on December 3, 1986. The samples were to be selectively analyzed for cadmium and lead via EPA Toxicity Extraction Procedure.

SAMPLE RECEIPT AND CHAIN OF CUSTODY

Routine inspection of the samples revealed them to be packaged properly and received in good condition.

Upon receipt, information from the submitted samples was recorded in the Master Log Book (and the LIMS computer system) and assigned ERT Control Numbers. These unique sample labels were affixed to respective sample containers and subsequently utilized throughout the laboratory analysis procedures for positive traceability.

ANALYTICAL PROCEDURES

The soil samples were analyzed according to procedures as outlined in "Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods," SW-846, 2nd Edition, revised April, 1984.

QUALITY CONTROL PROCEDURES

Standard quality control procedures were implemented for all analyses. Laboratory reagent (method) blanks, laboratory duplicated samples, and laboratory fortified control samples were analyzed concurrently with each case of submitted samples. The laboratory normally prepares and analyzes one (1) blank, one (1) fortified sample, and one (1) duplicate sample for each case of samples received or for each twenty (20) samples, whichever is more frequent. A case consists of a finite, usually predetermined number of samples collected over a given time period from one particular site. Duplicate sample analyses are performed only when sufficient sample volume is received. The results of the analyses are reviewed by the laboratory quality control coordinator to insure compliance with established analytical control limits.

Laboratory prepared method blank samples and fortified samples are identified in the analytical result tables under the Field Identification number using a unique numbering system and also assigning one ERT sample number to each sample. The Prefex "MB" refers to Method Blank, and "LF" refers to Laboratory Fortification (i.e., a quality control recovery sample).

In most cases, the analytical results will have been corrected using mean method blank results.

RESULTS OF ANALYSIS

Analytical results for the submitted samples are presented in the appended tables. Summary tables for the results of duplicate, blank, and fortified control samples have also been provided in the Appendix.

DISCUSSION

Review of the results of the quality control/quality assurance samples analyzed concurrently with the submitted samples indicated that the analyses were within the acceptance criteria as established by the U.S. EPA.

DATA AND REPORT APPROVAL FORM

SUBMITTED BY:

Analytical Chemistry Laboratory
ERT A Resource Engineering Company
696 Virginia Road
Concord, Massachusetts
December 18, 1986

DATA REVIEWED BY:

Arthur P. Paradice

Arthur P Paradice
Inorganic Supervisor

Thomas M. Trainor

TM Trainor (MCB)
Organic Supervisor

DATA AUDITED BY:

Mary Ann H. Becker

Mary Ann Becker
Quality Control Coordinator

REPORT APPROVED BY:

Joseph D. Mastone

Joseph D Mastone
Laboratory Manager

CADMIUM AND LEAD ANALYSES IN SOIL

Summary of Analytical Results

Duplicate Sample Results

Method Blank Results

Quality Control Sample Results

ERT ANALYTICAL LABORATORY
SUMMARY OF ANALYTICAL RESULTS
EP TOX METALS

ERT NO : 40571
FLD ID : A1

DATE SAMPLED : 11/18/86
CLIENT : CHEMETCO, INC.
SAMPLING SITE : ALTON, IL

PARAMETER	RESULT mg/l	DETECTION LIMIT mg/l
CADMIUM	BDL	.05
LEAD	BDL	.05

ERT ANALYTICAL LABORATORY
SUMMARY OF ANALYTICAL RESULTS
EP TOX METALS

ERT NO : 40572
FLD ID : A2

DATE SAMPLED : 11/18/86
CLIENT : CHEMETCO, INC.
SAMPLING SITE : ALTON, IL

PARAMETER	RESULT mg/l	DETECTION LIMIT mg/l
CADMIUM	BDL	.05
LEAD	BDL	.05

ERT ANALYTICAL LABORATORY
SUMMARY OF ANALYTICAL RESULTS
EP TOX METALS

ERT NO : 40573
FLD ID : A3

DATE SAMPLED : 11/18/86
CLIENT : CHEMETCO, INC.
SAMPLING SITE : ALTON, IL

PARAMETER	RESULT mg/l	DETECTION LIMIT mg/l
CADMIUM	BDL	.05
LEAD	BDL	.05

ERT ANALYTICAL LABORATORY
SUMMARY OF ANALYTICAL RESULTS
EP TOX METALS

ERT NO : 40574
FLD ID : A4

DATE SAMPLED : 11/18/86
CLIENT : CHEMETCO, INC.
SAMPLING SITE : ALTON, IL

PARAMETER	RESULT mg/l	DETECTION LIMIT mg/l
CADMIUM	BDL	.05
LEAD	BDL	.05

ERT ANALYTICAL LABORATORY
SUMMARY OF ANALYTICAL RESULTS
EP TOX METALS

ERT NO : 40575
FLD ID : A5

DATE SAMPLED : 11/18/86
CLIENT : CHEMETCO, INC.
SAMPLING SITE : ALTON, IL

PARAMETER	RESULT mg/l	DETECTION LIMIT mg/l
CADMIUM	BDL	.05
LEAD	BDL	.05

ERT ANALYTICAL LABORATORY
SUMMARY OF ANALYTICAL RESULTS
EP TOX METALS

ERT NO : 40576
FLD ID : B1

DATE SAMPLED : 11/18/86
CLIENT : CHEMETCO, INC.
SAMPLING SITE : ALTON, IL

PARAMETER	RESULT mg/l	DETECTION LIMIT mg/l
CADMIUM	BDL	.05
LEAD	BDL	.05

ERT ANALYTICAL LABORATORY
SUMMARY OF ANALYTICAL RESULTS
EP TOX METALS

ERT NO : 40577
FLD ID : B2

DATE SAMPLED : 11/18/86
CLIENT : CHEMETCO, INC.
SAMPLING SITE : ALTON, IL

PARAMETER	RESULT mg/l	DETECTION LIMIT mg/l
CADMIUM	BDL	.05
LEAD	BDL	.05

ERT ANALYTICAL LABORATORY
SUMMARY OF ANALYTICAL RESULTS
EP TOX METALS

ERT NO : 40578
FLD ID : B3

DATE SAMPLED : 11/18/86
CLIENT : CHEMETCO, INC.
SAMPLING SITE : ALTON, IL

PARAMETER	RESULT mg/l	DETECTION LIMIT mg/l
CADMIUM	BDL	.05
LEAD	BDL	.05

ERT ANALYTICAL LABORATORY
SUMMARY OF ANALYTICAL RESULTS
EP TOX METALS

ERT NO : 40579
FLD ID : B4

DATE SAMPLED : 11/18/86
CLIENT : CHEMETCO, INC.
SAMPLING SITE : ALTON, IL

PARAMETER	RESULT mg/l	DETECTION LIMIT mg/l
CADMIUM	BDL	.05
LEAD	BDL	.05

ERT ANALYTICAL LABORATORY
SUMMARY OF ANALYTICAL RESULTS
EP TOX METALS

ERT NO : 40580
FLD ID : B5

DATE SAMPLED : 11/18/86
CLIENT : CHEMETCO, INC.
SAMPLING SITE : ALTON, IL

PARAMETER	RESULT mg/l	DETECTION LIMIT mg/l
CADMIUM	BDL	.05
LEAD	BDL	.05

ERT ANALYTICAL LABORATORY
SUMMARY OF ANALYTICAL RESULTS
EP TOX METALS

ERT NO : 40581
FLD ID : C1'

DATE SAMPLED : 11/18/86
CLIENT : CHEMETCO, INC.
SAMPLING SITE : ALTON, IL

PARAMETER	RESULT mg/l	DETECTION LIMIT mg/l
CADMIUM	BDL	.05
LEAD	BDL	.05

ERT ANALYTICAL LABORATORY
SUMMARY OF ANALYTICAL RESULTS
EP TOX METALS

ERT NO : 40582
FLD ID : C2,

DATE SAMPLED : 11/18/86
CLIENT : CHEMETCO, INC.
SAMPLING SITE : ALTON, IL

PARAMETER	RESULT mg/l	DETECTION LIMIT mg/l
CADMIUM	BDL	.05
LEAD	BDL	.05

ERT ANALYTICAL LABORATORY
SUMMARY OF ANALYTICAL RESULTS
EP TOX METALS

ERT NO : 40583
FLD ID : C3

DATE SAMPLED : 11/18/86
CLIENT : CHEMETCO, INC.
SAMPLING SITE : ALTON, IL

PARAMETER	RESULT mg/l	DETECTION LIMIT mg/l
CADMIUM	BDL	.05
LEAD	BDL	.05

ERT ANALYTICAL LABORATORY
SUMMARY OF ANALYTICAL RESULTS
EP TOX METALS

ERT NO : 40584
FLD ID : C4

DATE SAMPLED : 11/18/86
CLIENT : CHEMETCO, INC.
SAMPLING SITE : ALTON, IL

PARAMETER	RESULT mg/l	DETECTION LIMIT mg/l
CADMIUM	BDL	.05
LEAD	BDL	.05

ERT ANALYTICAL LABORATORY
SUMMARY OF ANALYTICAL RESULTS
EP TOX METALS

ERT NO : 40585
FLD ID : C5

DATE SAMPLED : 11/18/86
CLIENT : CHEMETCO,INC.
SAMPLING SITE : ALTON, IL

PARAMETER	RESULT mg/l	DETECTION LIMIT mg/l
CADMIUM	BDL	.05
LEAD	BDL	.05

ERT ANALYTICAL LABORATORY
SUMMARY OF ANALYTICAL RESULTS
EP TOX METALS

ERT NO : 40586
FLD ID : D1

DATE SAMPLED : 11/18/86
CLIENT : CHEMETCO, INC.
SAMPLING SITE : ALTON, IL

PARAMETER	RESULT mg/l	DETECTION LIMIT mg/l
CADMIUM	BDL	.05
LEAD	BDL	.05

ERT ANALYTICAL LABORATORY
SUMMARY OF ANALYTICAL RESULTS
EP TOX METALS

ERT NO : 40587
FLD ID : D2

DATE SAMPLED : 11/18/86
CLIENT : CHEMETCO, INC.
SAMPLING SITE : ALTON, IL

PARAMETER	RESULT mg/l	DETECTION LIMIT mg/l
CADMIUM	BDL	.05
LEAD	BDL	.05

ERT ANALYTICAL LABORATORY
SUMMARY OF ANALYTICAL RESULTS
EP TOX METALS

ERT NO : 40588
FLD ID : D3

DATE SAMPLED : 11/18/86
CLIENT : CHEMETCO, INC.
SAMPLING SITE : ALTON, IL

PARAMETER	RESULT mg/l	DETECTION LIMIT mg/l
CADMIUM	BDL	.05
LEAD	BDL	.05

ERT ANALYTICAL LABORATORY
SUMMARY OF ANALYTICAL RESULTS
EP TOX METALS

ERT NO : 40589
FLD ID : D4

DATE SAMPLED : 11/18/86
CLIENT : CHEMETCO, INC.
SAMPLING SITE : ALTON, IL

PARAMETER	RESULT mg/l	DETECTION LIMIT mg/l
CADMIUM	BDL	.05
LEAD	BDL	.05

ERT ANALYTICAL LABORATORY
SUMMARY OF ANALYTICAL RESULTS
EP TOX METALS

ERT NO : 40590
FLD ID : D5

DATE SAMPLED : 11/18/86
CLIENT : CHEMETCO, INC.
SAMPLING SITE : ALTON, IL

PARAMETER	RESULT mg/l	DETECTION LIMIT mg/l
CADMIUM	BDL	.05
LEAD	BDL	.05

ERT ANALYTICAL LABORATORY
SUMMARY OF ANALYTICAL RESULTS
EP TOX METALS

ERT NO : 40591
FLD ID : E1

DATE SAMPLED : 11/18/86
CLIENT : CHEMETCO, INC.
SAMPLING SITE : ALTON, IL

PARAMETER	RESULT mg/l	DETECTION LIMIT mg/l
CADMIUM	BDL	.05
LEAD	BDL	.05

ERT ANALYTICAL LABORATORY
SUMMARY OF ANALYTICAL RESULTS
EP TOX METALS

ERT NO : 40592
FLD ID : E2

DATE SAMPLED : 11/18/86
CLIENT : CHEMETCO, INC.
SAMPLING SITE : ALTON, IL

PARAMETER	RESULT mg/l	DETECTION LIMIT mg/l
CADMIUM	BDL	.05
LEAD	BDL	.05

ERT ANALYTICAL LABORATORY
SUMMARY OF ANALYTICAL RESULTS
EP TOX METALS

ERT NO : 40593
FLD ID : E3

DATE SAMPLED : 11/18/86
CLIENT : CHEMETCO, INC.
SAMPLING SITE : ALTON, IL

PARAMETER	RESULT mg/l	DETECTION LIMIT mg/l
CADMIUM	BDL	.05
LEAD	BDL	.05

ERT ANALYTICAL LABORATORY
SUMMARY OF ANALYTICAL RESULTS
EP TOX METALS

ERT NO : 40594
FLD ID : E4

DATE SAMPLED : 11/18/86
CLIENT : CHEMETCO, INC.
SAMPLING SITE : ALTON, IL

PARAMETER	RESULT mg/l	DETECTION LIMIT mg/l
CADMIUM	BDL	.05
LEAD	BDL	.05

ERT ANALYTICAL LABORATORY
SUMMARY OF ANALYTICAL RESULTS
EP TOX METALS

ERT NO : 40595
FLD ID : E5

DATE SAMPLED : 11/18/86
CLIENT : CHEMETCO, INC.
SAMPLING SITE : ALTON, IL

PARAMETER	RESULT mg/l	DETECTION LIMIT mg/l
CADMIUM	BDL	.05
LEAD	BDL	.05

ERT ANALYTICAL LABORATORY
SUMMARY OF ANALYTICAL RESULTS
EP TOX METALS

ERT NO : 40596
FLD ID : F1

DATE SAMPLED : 11/18/86
CLIENT : CHEMETCO, INC.
SAMPLING SITE : ALTON, IL

PARAMETER	RESULT mg/l	DETECTION LIMIT mg/l
CADMIUM	BDL	.05
LEAD	BDL	.05

ERT ANALYTICAL LABORATORY
SUMMARY OF ANALYTICAL RESULTS
EP TOX METALS

ERT NO : 40597
FLD ID : F2

DATE SAMPLED : 11/18/86
CLIENT : CHEMETCO, INC.
SAMPLING SITE : ALTON, IL

PARAMETER	RESULT mg/l	DETECTION LIMIT mg/l
CADMIUM	BDL	.05
LEAD	BDL	.05

ERT ANALYTICAL LABORATORY
SUMMARY OF ANALYTICAL RESULTS
EP TOX METALS

ERT NO : 40598
FLD ID : F3

DATE SAMPLED : 11/18/86
CLIENT : CHEMETCO, INC.
SAMPLING SITE : ALTON, IL

PARAMETER	RESULT mg/l	DETECTION LIMIT mg/l
CADMIUM	BDL	.05
LEAD	BDL	.05

ERT ANALYTICAL LABORATORY
SUMMARY OF ANALYTICAL RESULTS
QUALITY CONTROL CHECK SAMPLES
EP TOX METALS

ERT NO : 40572A
FLD ID : LF861052

DATE SAMPLED : 12/09/86
CLIENT : CHEMETCO,INC.
SAMPLING SITE : ALTON, IL

PARAMETER	ANALYTICAL RESULTS ug/ml	DETECTION LIMIT ug/ml
CADMIUM	1.94	0.050
LEAD	1.94	0.050

ERT ANALYTICAL LABORATORY
SUMMARY OF ANALYTICAL RESULTS
QUALITY CONTROL CHECK SAMPLES
EP TOX METALS

ERT NO : 40572B
FLD ID : LF861053

DATE SAMPLED : 12/09/86
CLIENT : CHEMETCO, INC.
SAMPLING SITE : ALTON, IL

PARAMETER	ANALYTICAL RESULTS ug/ml	DETECTION LIMIT ug/ml
CADMIUM	1.85	0.050
LEAD	1.85	0.050

ERT ANALYTICAL LABORATORY
SUMMARY OF ANALYTICAL RESULTS
QUALITY CONTROL CHECK SAMPLES
EP TOX METALS

ERT NO : 40574A
FLD ID : LF861054

DATE SAMPLED : 12/09/86
CLIENT : CHEMETCO, INC.
SAMPLING SITE : ALTON, IL

PARAMETER	ANALYTICAL RESULTS ug/ml	DETECTION LIMIT ug/ml
CADMIUM	1.95	0.050
LEAD	1.95	0.050

ERT ANALYTICAL LABORATORY
SUMMARY OF ANALYTICAL RESULTS
QUALITY CONTROL CHECK SAMPLES
EP TOX METALS

ERT NO : 40574B
FLD ID : LF861055

DATE SAMPLED : 12/09/86
CLIENT : CHEMETCO, INC.
SAMPLING SITE : ALTON, IL

PARAMETER	ANALYTICAL RESULTS ug/ml	DETECTION LIMIT ug/ml
CADMIUM	1.87	0.050
LEAD	1.89	0.050

ERT ANALYTICAL LABORATORY
SUMMARY OF ANALYTICAL RESULTS
QUALITY CONTROL CHECK SAMPLES
EP TOX METALS

ERT NO : 40598A
FLD ID : LF861067

DATE SAMPLED : 12/10/86
CLIENT : CHEMETCO, INC.
SAMPLING SITE : ALTON, IL

PARAMETER	ANALYTICAL RESULTS ug/ml	DETECTION LIMIT ug/ml
CADMIUM	1.87	0.050
LEAD	1.86	0.050

ERT ANALYTICAL LABORATORY
SUMMARY OF ANALYTICAL RESULTS
QUALITY CONTROL CHECK SAMPLES
EP TOX METALS

ERT NO : 40598B
FLD ID : LF861068

DATE SAMPLED : 12/10/86
CLIENT : CHEMETCO, INC.
SAMPLING SITE : ALTON, IL

PARAMETER	ANALYTICAL RESULTS ug/ml	DETECTION LIMIT ug/ml
CADMIUM	1.84	0.050
LEAD	1.82	0.050

ERT ANALYTICAL LABORATORY
SUMMARY OF ANALYTICAL RESULTS
METALS SCAN

ERT NO : 40761
FLD ID : MB860936

DATE SAMPLED : 12/09/86
CLIENT : CHEMETCO, INC.
SAMPLING SITE : ERT CONCORD

PARAMETER	RESULT mg/l	DETECTION LIMIT mg/l
CADMIUM	BDL	.05
LEAD	BDL	.05

ERT ANALYTICAL LABORATORY
SUMMARY OF ANALYTICAL RESULTS
METALS SCAN

ERT NO : 40762
FLD ID : MB860937

DATE SAMPLED : 12/09/86
CLIENT : CHEMETCO,INC.
SAMPLING SITE : ERT CONCORD

PARAMETER	RESULT mg/l	DETECTION LIMIT mg/l
CADMIUM	BDL	.05
LEAD	BDL	.05

ERT ANALYTICAL LABORATORY
SUMMARY OF ANALYTICAL RESULTS
EP TOX METALS

ERT NO : 40876
FLD ID : MB860943

DATE SAMPLED : 12/10/86
CLIENT : CHEMETCO, INC.
SAMPLING SITE : ERT CONCORD

PARAMETER	RESULT mg/l	DETECTION LIMIT mg/l
CADMIUM	BDL	.05
LEAD	BDL	.05

ERT ANALYTICAL LABORATORY
SUMMARY OF ANALYTICAL RESULTS
QUALITY CONTROL CHECK SAMPLES
EP TOX METALS

ERT NO : 40763
FLD ID : LF861052

DATE SAMPLED : 12/09/86
CLIENT : CHEMETCO, INC.
SAMPLING SITE : ALTON, IL

PARAMETER	% RECOVERY
CADMIUM	97
LEAD	97

ERT ANALYTICAL LABORATORY
SUMMARY OF ANALYTICAL RESULTS
QUALITY CONTROL CHECK SAMPLES
EP TOX METALS

ERT NO : 40766
FLD ID : LF861055

DATE SAMPLED : 12/09/86
CLIENT : CHEMETCO, INC.
SAMPLING SITE : ALTON, IL

PARAMETER	% RECOVERY
CADMIUM	94
LEAD	95

ERT ANALYTICAL LABORATORY
SUMMARY OF ANALYTICAL RESULTS
QUALITY CONTROL CHECK SAMPLES
EP TOX METALS

ERT NO : 40877
FLD ID : LF861067

DATE SAMPLED : 12/10/86
CLIENT : CHEMETCO, INC.
SAMPLING SITE : ALTON, IL

PARAMETER	% RECOVERY
CADMIUM	94
LEAD	93

ERT ANALYTICAL LABORATORY
SUMMARY OF ANALYTICAL RESULTS
QUALITY CONTROL CHECK SAMPLES
EP TOX METALS

ERT NO : 40878
FLD ID : LF861068

DATE SAMPLED : 12/10/86
CLIENT : CHEMETCO, INC.
SAMPLING SITE : ALTON, IL

PARAMETER	% RECOVERY
CADMIUM	92
LEAD	91

SOILSP

~~D204-158~~ 0005-255

CHEMETCO INC
SOIL SAMPLING / ANALYSIS
CHAIN OF CUSTODY RECORD / ANALYSIS REQUEST

SAMPLE COLLECTION MT003

ANALYTICAL LABORATORY

SAMPLE NUMBER	PRESERVATION	ANALYSIS REQD	DATE SENT	DATE RECEIVED	TIME RECEIVED	RECEIVED BY	ERT#
A1	None	EPTox Pb & Cd	Nov 18	12/3/86	11:00	[illegible]	40571
A2	✓	✓	✓				40572
A3	✓	✓	✓				40573
A4	✓	✓	✓				40574
A5	✓	✓	✓				40575
B1	None	✓	✓				40576
B2	✓	✓	✓				40577
B3	✓	✓	✓				40578
B4	✓	✓	✓				40579
B5	✓	✓	✓				40580
C1	None	✓	✓				40581
C2	✓	✓	✓				40582
C3	✓	✓	✓				40583
C4	✓	✓	✓				40584
C5	✓	✓	Nov 18				40585
D1	None	✓	✓				40586
D2	✓	✓	✓				40587
D3	✓	✓	✓				40588
D4	✓	✓	✓				40589
D5	✓	✓	✓				40590
E1	None	✓	✓				40591
E2	✓	✓	✓				40592
E3	✓	✓	Nov 18				40593
E4	✓	✓	✓				40594
E5	✓	✓	✓				40595
F1	None	✓	✓				40596
F2	✓	✓	✓				40597
F3	✓	✓	✓				40598

QUALITY ASSURANCE NOTICE

Sample # ZOB, FWWI

Sample I.D.: 224378, 224379

Method blank I.D.: 224493

CompuChem offers various types of analytical services, two of which are characterized as "Volatile Analysis by GC/MS--Method 8240" and "Semivolatile Analysis by GC/MS--Method 8270." Many of the Quality Control requirements of these methods were derived from the EPA's Contract Laboratory Program (CLP). Following the conventions established by the EPA for qualifying common laboratory artifacts in samples analyzed under the CLP Caucus Organics Protocols, we have reported the following compound(s) with the "B" footnote:

common laboratory artifact	concentration	units
Methylene Chloride	7 J	ug/kg
Acetone	11	ug/kg

The reporting convention used in the CLP is to "flag" with a "B" all allowable analytes present in the sample and its associated Method Blank (and/or Instrument Blank). No adjustments are made to the analytical results.

The CLP protocols allow certain levels of common laboratory solvents (acetone, methylene chloride, and toluene) and phthalates to be present in blanks, up to five times the Contract Required Detection Limit (CRDL). CompuChem has a more stringent policy for liquid samples, which allows up to a maximum of twice the CRDL for the common solvents and phthalates. The only exception to our policy is made when the volatile analysis or extraction holding times are in jeopardy of being exceeded, then CLP requirements must be met.

This Notice serves to explain the use of the "B" flag in reporting analytical results, while presenting the actual levels of the common laboratory solvents or phthalates seen in the associated blank.

Data Interpretation: General EPA Guidelines

In evaluating data usablility, the EPA uses certain general guidelines for assessing the presence of common laboratory artifacts in samples. If the concentration of an artifact in a sample is greater than ten times that in the blank, the blank contribution is considered negligible. If blank and sample concentrations are comparable (sample level not greater than twice the blank level), the presence of that compound in the sample is considered suspect.

J - Estimated concentration of analyte which is present but at a concentration less than the stated detection limit.

Robert J. Whitehead
Manager, Quality Assurance

APPENDIX D ANALYSIS
Floor Wash Water Impoundment

Organophosphorus Pesticides - Method 8140

Parameter	Assay	Det. Limit
Famphur		[illegible]
O,O-Diethyl-O-2-Pyrazinyl Phosphorothioate (Thianazin/Zinophos)		[illegible]
Dimethoate	BDL	[illegible]
Disulfoton	BDL	[illegible]
Methyl Parathion	BDL	[illegible]
Parathion	BDL	[illegible]
Phorate	BDL	[illegible]
Tetraethyldithiopyrophosphonate (Sulfotepp)	BDL	[illegible]

Semi-volatile Organics - Method 8270

N-Nitrosodimethylamine	BDL	420 ug/kg
Pyridine	BDL	420
Ethylmethacrylate	BDL	420
Paraldehyde	BDL	420
2-Picoline	BDL	850
Nitrosomethylethylamine	BDL	420
Methyl Methane Sulfonate	BDL	420
N-Nitrosodiethylamine	BDL	420
Ethyl Methanesulfonate	BDL	420
Phenol	[illegible] ug/kg	420
Phenol 2nd run	110 ug/kg	420
Aniline	BDL	420
Pentachloroethane	BDL	420
Bis(2-Chloroethyl) ether	BDL	850
2-Chlorophenol	BDL	420
1,3-Dichlorobenzene	BDL	420
1,4-Dichlorobenzene	BDL	420
Benzyl Chloride	BDL	420
Benzyl Alcohol	BDL	420
1,2-Dichlorobenzene	BDL	420
2-Methylphenol	BDL	420
Bis(2-Chloroisopropyl)ether	BDL	420
3-Methylphenol	BDL	420
4-Methylphenol	BDL	420
N-Nitrosopyrrolodine	BDL	420
N-Nitrosomorpholine	BDL	420
Acetophenone	BDL	420
N-Nitroso-Di-N-Propylamine	BDL	420
O-Toluidine Hydrochloride	BDL	420
Hexachloroethane	BDL	420
Nitrobenzene	BDL	420

N-Nitrosopiperidine	BDL	420
Isophorone	BDL	420
2,4-Dimethylphenol	BDL	[illegible]
2-Nitrophenol	BDL	420
1,3,5-Trichlorobenzene	BDL	420
Benzoyl Chloride	BDL	420
Benzoic Acid	BDL	4200
Bis(2-Chloroethoxy)Methane	BDL	420
2,4-Dichlorophenol	BDL	420
1,2,4-Trichlorobenzene	BDL	420
Naphthalene	BDL	420
4-Chloroaniline	BDL	420
2,6-Dichlorophenol	BDL	850
-Phenylaminediorime	BDL	420
Alpha.Alpha Dimethylphenethylamine	BDL	420
Hexachloropropene	BDL	420
Hexachlorobutadiene	BDL	420
1,2,3-Trichlorobenzene	BDL	420
Benzotrichloride	BDL	850
N-Nitroso-Di-N-Butylamine	BDL	420
4-Chloro-M-Cresol	BDL	420
O-Phenylenediamine	BDL	420
Safrole	BDL	420
M-Phenylenediamine	BDL	420
2-Methylnaphthalene	BDL	420
1-Methylnaphthalene	BDL	420
1,2,4,5-Tetrachlorobenzene	BDL	420
1,2,3,5-Tetrachlorobenzene	BDL	420
Hexachlorocyclopentadiene	BDL	420
2,4,6-Trichlorophenol	BDL	850
2,4,5-Trichlorophenol	BDL	850
Isosafrole	BDL	850
2-Chloronaphthalene	BDL	420
1,2,3,4-Tetrachlorobenzene	BDL	420
2-Nitroaniline	BDL	420
1,4-Naphthoquinone	BDL	850
1,3-Dinitrobenzene	BDL	850
Dimethyl Phthalate	BDL	420
2,6-Dinitrotoluene	BDL	420
Acenaphthylene	BDL	420
3-Nitroaniline	BDL	850
Acenaphthene	BDL	420
2,4 Dinitrophenol	BDL	1700
4-Nitrophenol	BDL	420
2,4-Dinitrotoluene	BDL	420
Dibenzofuran	BDL	420
Pentachlorobenzene	BDL	420
1-Naphthylamine	BDL	850
2-Naphthylamine	BDL	850
2,3,4,6-Tetrachlorophenol	BDL	850
Diethyl Phthalate	BDL	420
Dinophos	BDL	420
4-Chlorophenyl Phenyl Ether	BDL	420
Flourene	BDL	420

Benzo(B)Fluoranthene 2nd run	420	420	"
7,12-Demethylbenzanthracene	BDL	420	"
Benzo(K)Fluoroanthene	BDL	420	"
Benzo(K)Fluoranthene 2nd run	420 (1)	420	"
Dimethoxybenzidine	BDL	420	"
Benzo(A)Pyrene	BDL	420	"
Benzo(A)Pyrene 2nd run	200 ug/kg	420	"
3-Methylchloranthrene	BDL	420	"
Indeno(1,2,3-C,D)Pyrene	BDL	420	"
Dibenzo(A,H)Anthracene	BDL	420	"
Dibenzo(A,J)Acridine	BDL	420	"
Benzo(G,H,I)Perylene	BDL	420	"

Note: The Semi-Volatiles were run twice for the Floor Wash Water Impoundment in a quality control effort. Unless otherwise noted, the results remained the same.

Fluoride and Sodium

Fluoride, total	5.6 mg/kg
Sodium, total	930 mg/kg

Cyanides - Analysis Code 415

Cyanide, total	BDL	.13 mg/kg

Pesticides/PCB's - Method No. 8080

Isodrin	N/A	
4,4'-DDD	BDL	4.4 ug/kg

Chlordane	BDL	[illegible]	
Dieldrin	BDL	[illegible]	
Endosulfan I	BDL	[illegible]	
Endosulfan II	BDL	[illegible]	
Endosulfan Sulfate	BDL	[illegible]	
Endrin	BDL	[illegible]	
Endrin Aldehyde	BDL	[illegible]	
Heptachlor	1.2	[illegible]	
Heptachlor Epoxide	BDL	[illegible]	
Kepone	BDL	[illegible]	
Methoxychlor	BDL	[illegible]	
PCB-1016	BDL	25	
PCB-1221	BDL	25	
PCB-1232	BDL	25	"
PCB-1242	BDL	25	"
PCB-1248	BDL	25	
PCB-1254	BDL	25	
PCB-1260	440 ug/kg	25	"
Toxaphene	BDL	25	
Alpha-BHC	BDL	[illegible]	
Beta-BHC	BDL	1.3	
Delta-BHC	BDL	[illegible]	
Gamma-BHC	BDL	[illegible]	

Volatiles - Method 8240

Chloromethane	BDL	13	ug/kg
Bromomethane	BDL	13	
Vinyl Chloride	BDL	13	"
Chloroethane	BDL	13	"
Methylene Chloride	20 B	13	"
Acetone (2-Propanone)	30 B	13	"
Carbon Disulfide	BDL	6	
1,1-Dichloroethene	BDL	6	
1,1-Dichloroethane	BDL	6	
1,2-Dichloroethene	BDL	6	"
Chloroform	[illegible]	6	
1,2-Dichloroethane	BDL	6	
2-Butanone	8	13	"
1,1,1-Trichloroethane	BDL	6	
Carbon Tetrachloride	BDL	6	
Vinyl acetate	BDL	[illegible]	"
Bromodichloromethane	BDL	6	"
1,2-Dichloropropane	BDL	6	"
Cis-1,3-Dichloropropene	BDL	6	
Trichloroethene	BDL	6	"
Dibromochloromethane	BDL	[illegible]	

...hloroethyl ...nyl ether	BDL	[illegible]
...moform	BDL	[illegible]
...-2-Pentanone	BDL	[illegible]
...exanone	BDL	[illegible] "
...etrachloroethene	BDL	[illegible] "
1,1,2,2-Tetrachloroethane	BDL	[illegible] "
...oluene	BDL	[illegible] "
Chlorobenzene	BDL	[illegible] "
Eth...benzene	BDL	[illegible] "
St...rene	BDL	[illegible] "
...tal ...ylenes	BDL	[illegible] "
Iodomethane	BDL	13 "
Acrolein	BDL	130 "
Acrylonitrile	BDL	130 "
Trichlorofluoromethane	BDL	13 "
3-Chloropropene	BDL	13 "
1,1,2-Trichloro-1,2,2-Triflouroethane	BDL	13 "
1,1,1-Trichloro-2,2,2-Triflouroethane	BDL	13 "
Dibromomethane	BDL	6 "
Propionaldehyde	BDL	130 "
1,2-Dibromoethane	BDL	6 "
1,1,1,2-Tetrachloroethane	BDLBDL	6 "
cis-1,4-Dichloro-2-Butene	BDL	13 "
1,2,3-Trichloropropane	BDL	13 "
trans-1,4-Dichloro-2-Butene	BDL	13 "
Ethylmethacrylate	BDL	13 "
1,2-Dibromo-3-Chloropropane	BDL	13 "

Herbicides - Method 8150

2,4-D	BDL	130 ug/kg
2,4,5-TP(Silvex)	BDL	13 "
2,4,5-T	BDL	13 "

Fluoride and Sodium

Fluoride, total	78.	1.0
Sodium, total	153 mg/kg	[illegible]

C.anides - Analysis code 415

Cyanide, total	2.0 mg/kg	.20 mg/kg

Pesticides/PCB's - Method 8080

Isodrin	N/A	
4,4'-DDD	BDL	73 ug/kg
4,4'-DDE	BDL	[illegible]
4,4'-DDT	BDL	
Aldrin	50 ug/kg	[illegible]
Chlordane	BDL	63
Dieldrin	BDL	31 "
Endosulfan I	BDL	[illegible]
Endosulfan II	BDL	73
Endosulfan Sulfate	BDL	12 "
Endrin	BDL	52 "
Endrin Aldehyde	BDL	20 "
Heptachlor	53 ug/kg	20 ug/kg
Heptachlor Epoxide	BDL	20 "
Kepone	BDL	20 "
Methoxychlor	BDL	73 "
PCB-1016	BDL	416 "
PCB-1221	BDL	416 "
PCB-1232	BDL	416 "
PCB-1242	BDL	416 "
PCB-1248	BDL	416 "
PCB-1254	BDL	416 "
PCB-1260	BDL	416 "
Toxaphene	BDL	416 "
Alpha-BHC	BDL	20 "
Beta-BHC	BDL	20 "
Delta-BHC	85 ug/kg	20 "
Gamma-BHC	BDL	20 "

1-Chloronaphthalene	BDL	690	"
4,6-Dinitro-2-Methylphenol	BDL	[illegible]	
N-Nitrosodiphenylamine	BDL	690	"
1,3,5-Trinitrobenzene	BDL	1400	
Phenacetin	BDL	690	"
4-Bromophenyl Phenyl Ether	BDL	690	
Diallate	BDL	690	"
Dimethoate	BDL	690	"
Hexachlorobenzene	420 ug/kg J	690	"
4-Aminobiphenyl	BDL	690	"
Pronamide	BDL	690	"
Pentachlorophenol	BDL	1400	"
Pentachloronitrobenzene	BDL	690	"
Phenanthrene	2800ug/kg J+	3500+	"
Anthracene	2400 "	690	"
Di-N-butyl Phthalate	BDL	690	"
Diphenylamine	BDL	690	"
Methapyrilene	BDL	1400	
Cyclophosphamide	BDL	3500	
Fluoranthene	28000 ug/kg +	3500 +	"
Benzidine	BDL	690	"
Pyrene	38000 ug/kg -	3500 -	"
Aramite	BDL	1400	"
4-Dimethylaminoazobenzene	BDL	690	"
Chlorobenzilate	BDL	690	"
3,3'-Demethylbenzidine	BDL	1400	"
Butylbenzyl Phthalate	BDL	690	"
2-Acetylamino Fluorene	BDL	690	"
4,4'-Methylene-bis(2-Chloroaniline)	BDL	690	"
3,3'-Dichlorobenzidine	BDL	690	"
Bis(2-ethylhexyl)Phthalate	7700ug/kg B	690	"
Benzo(A)Anthracene	900 "	690	"
Chrysene	13000 ug/kg+	3500+	"
Di-N-Octyl Phthalate	BDL	690	"
Benzo(B)Fluoanthene	22000 ug/kg+	3500+	"
7,12-Demethylbenzanthracene	BDL	690	"
Benzo(K)Fluoroanthene	22000 ug/kg+	3500+	
Dimethoxybenzidine	BDL	690	"
Benzo(A)Pyrene	13000 ug/kg+	3500+	"
3-Methylchloranthrene	BDL	690	"
Indeno(1,2,3-C,D)Pyrene	5600ug/kg	690	"
Dibenzo(A,H)Anthracene	980 "	690	"
Dibenzo(A,J)Acridine	BDL	690	"
Benzo(G,H,I)Perylene	7100ug/kg	690	"

2-Nitrophenol	BDL		690	
1,3,5 Trichlorobenzene	BDL		690	"
Benzal Chloride	BDL		690	
Benzoic Acid	BDL		3400	
bis(2-Chloroethoxy)Methane	BDL		690	"
2,4-Dichlorophenol	BDL		690	"
1,2,4-Trichlorobenzene	BDL		690	"
Naphthalene	250	ug/kg J	690	"
4 Chloroaniline	BDL		690	
2,6-Dichlorophenol	BDL		1400	"
P-Phenylaminedianime	BDL		690	"
Alpha,Alpha Dimethylphenethylamine	BDL		690	"
Hexachloropropene	BDL		690	"
Hexachlorobutadiene	BDL		690	"
1,2,3-Trichlorobenzene	BDL		690	"
Benzotrichloride	BDL		1400	"
N-Nitroso-Di-N-Butylamine	BDL		690	"
4-Chloro-M-Cresol	BDL		690	"
P-Phenylenediamine	BDL		690	"
Safrole	BDL		690	"
M-Phenylenediamine	BDL		690	"
2-Methylnaphthalene	BDL		690	"
1-Methylnaphthalene	100	ug/kg J	690	"
1,2,4,5-Tetrachlorobenzene	BDL		690	"
1,2,3,5-Tetrachlorobenzene	BDL		690	"
Hexachlorocyclopentadiene	BDL		690	"
2,4,6-Trichlorophenol	BDL		1400	"
2,4,5-Trichlorophenol	BDL		1400	"
Isosafrole	BDL		1400	"
2-Chloronaphthalene	BDL		690	"
1,2,3,4-Tetrachlorobenzene	BDL		690	"
2-Nitroaniline	BDL		690	"
1,4-Naphthoquinone	BDL		1400	"
1,3-Dinitrobenzene	BDL		1400	"
Dimethyl Phthalate	BDL		690	"
2,6-Dinitrotoluene	BDL		690	"
Acenaphthylene	460	ug/kg J	690	"
3-Nitroaniline	BDL		1400	"
Acenaphthene	BDL		690	"
2,4-Dinitrophenol	BDL		2800	"
4-Nitrophenol	BDL		690	
2,4-Dinitrotoluene	BDL		690	"
Dibenzofuran	200	ug/kg J	690	"
Pentachlorobenzene	120	" "	690	"
1-Naphthylamine	BDL		1400	"
2-Naphthylamine	BDL		1400	"
2,3,4,6-Tetrachlorophenol	BDL		1400	"
Diethyl Phthalate	BDL		690	"
Zinophos	BDL		690	"
4-Chlorophenyl Phenyl Ether	BDL		690	"
Fluorene	890	ug/kg J	690	"
4-Nitroaniline	BDL		1400	"
5-Nitro-O-Toluidine	BDL		1400	"
1,2 Diphenylhydrazine (Azobenzene)	BDL		690	"

Appendix 3:
Material Specifications for Final Cover and Quality Assurance/Quality Control

B. BACKFILL

B.1 Scope

The work under this section includes the furnishing of all labor, equipment, materials and the performing of all operations in connection with furnishing, placing, grading and compacting backfill to the limits shown on the drawings.

B.2 Materials

Material for backfill shall be a natural soil composed of clay, sand, silt and/or gravelly sand and shall be from off-site sources. Backfill texture shall conform to one or more of the following soil groups as defined by the Unified Soil Classification System:

Symbol	Description
SW	well graded sands, gravelly sands, little or no fines
SM	silty sands, sand-silt mixtures
SP	poorly graded sands or gravelly sands, little or no fines
SC	clayey sands, sand-clay mixtures
CL	inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
CH	inorganic clays of high plasticity, fat clays

Prior to backfill placement, one representative sample from each source shall be submitted to an independent soil testing laboratory for the determination of optimum moisture content and maximum density according to ASTM Method D-698 Standard Proctor Test. The contractor shall be responsible for identifying the sources and shall obtain representative samples and submit the samples to an Owner-approved laboratory. The contractor shall provide the test results to the Owner. Testing and acceptance shall conform to the procedures described in Appendix I-2, "Construction Quality Assurance and Quality Control Plan".

B.3 Placement and Compaction

Backfill shall be placed within the fill limits shown on the drawings. Backfill shall be placed in layers and compacted according to the type of soil used as fill. For soil types SW, SM and SP, a track-type tractor or rubber tired roller shall be utilized. SW, SM and SP type backfill shall be placed in lifts so that the compacted layer is not thicker than 12 inches. Track type tractors shall weigh at least 30,000 lbs*. Rubber tired rollers shall have a wheel load in excess of 15,000* lbs. Each layer shall be compacted by not less than six passes of the equipment. A complete pass shall consist of the entire coverage of the layer with one trip of the equipment. Each trip shall over lap the adjacent trip by not less than two (2) feet.

For soil types SC, CL and CH, a rubber tired roller or tamping (sheepsfoot) roller will be used. If the rubber tired roller is selected, the compaction equipment requirement shall be the same as described in the above paragraph for soil types SW, SM and SP. If a sheepsfoot roller is selected, the layer thickness shall not be thicker than six (6) inches after compaction. The length of the foot on the sheepsfoot roller shall not be less than seven and one-half (7 1/2) inches. The *Corps of Engineers, Bureau of Land Reclamation recommendations in Soils Manual (The Asphalt Institute) loaded weight of the sheepsfoot roller shall not be less than 30,000 lbs*. Each layer compacted by the sheepsfoot roller shall be compacted by not less than six (6) passes. A complete pass shall consist of the entire coverage of the layer with one trip of the sheepsfoot roller. Each trip shall overlap the adjacent trip by not less than two (2) feet. The moisture content of the backfill shall be three (3) to five (5) percent above the optimum moisture content as determined by the Standard Proctor Test (ASTM D-698).

Each lift shall be compacted to at least 90% of maximum dry density as determined by the Owner's Inspector, as described in Appendix I-2, "Construction Quality Assurance and Quality Control Plan".

B.4 Grading

Backfill shall be placed in compacted lifts until a point has been reached that is 2 feet 6 inches below the final grade, as shown on the drawings. The completed backfill surface shall be rough graded and uniform.

*EPA Seminar - Requirements for Hazardous Waste Landfill Design, Construction & Closure (Presentations, 1988).

C. CLAY COVER

C.1 Scope

The work under this section includes the furnishing of all labor, equipment, materials, and the performing of all operations in connection with furnishing, placing, grading, and compacting a clay cover over the backfill.

C.2 Materials

Cover material shall be a natural soil composed of clay and silt. It shall be free of boulders, brush, stumps, waste or debris, and similar materials. Cover material shall be uncontaminated and will be obtained from an off-site source. The responsibility for Quality Assurance shall be placed upon the contractor providing cover material. In delivering cover material the contractor shall provide to the Owner the source location and assurance that materials have not been removed from a previous industrialized location where contamination of the material is likely to have occurred.

Quality Control will be the responsibility of the Owner. QC measures will include confirmation of the source location and random visual inspections of the material as it is being delivered to the site to confirm the absence of any obvious unnatural staining and other foreign materials (e.g., broken bricks, concrete, rubber) which might indicate an unacceptable source or previous industrial application.

Cover material texture shall conform to one or more of the following soil groups as defined by the Unified Soil Classification System:

Symbol	Description
CL	inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
CH	inorganic clays of high plasticity, fat clays

Prior to cover placement one representative sample of cover material from each source shall be submitted to an independent soil testing laboratory for the determination of moisture content, grain size distribution, specific gravity, liquid and plastic limits, moisture-density relationship, and hydraulic conductivities at various densities and moisture contents. A sufficient number of tests will be accomplished upon representative samples of the cohesive clay or silt (CL, or CH) proposed to be furnished for use in the clay cover to determine the most practical combination of densities and moisture contents to assure an in-place coefficient of permeability of not more than 1 x 10^{-7} cm/sec. At least one lab permeability test series shall be performed for every 10,000 cubic yards of soil to be used as the clay cover. The Contractor shall be responsible for identifying the sources, and shall obtain and submit the samples to an Owner-approved laboratory. The Contractor shall be responsible for identifying the sources, and shall obtain and submit the samples to an Owner-approved laboratory. The Contractor shall provide test results to the Owner. Testing and acceptance shall conform to the procedures described in Appendix I-4, "Construction Quality Assurance and Quality Control Plan".

C.3 Placement and Compaction

The cover shall be placed and spread in layers so that the total compacted thickness of the clay is not less than 18 inches. Each individual layer will not exceed six (6) inches. The cover shall be compacted by a sheepsfoot roller with feet 3ot less than seven and one half (7 1/2) inches in length. The loaded weight of the sheepsfoot roller shall not be less than 30,000 lbs. Each layer shall be compacted by not less than six (6) passes. A complete pass shall consist of the entire coverage of the layer with one trip of the roller. Each trip shall overlap the adjacent trip by not less than two (2) feet.

Each lift shall be placed to achieve a moisture content and dry density that is within the acceptable range for the required hydraulic conductivity. The acceptable range will be determined by material testing as described in C.2 above. The field density of the compacted final cover shall be field tested by the Owner's Inspector as described in Appendix I-4.

C.4 Grading

Cover material shall be placed in compacted lifts until a point has been reached that is 12 inches below the final grade, as shown on the drawings. The completed cover surface shall be rough graded and uniform.

C.5 Soil Testing

Soil testing shall be performed in accordance with Technical Specification F entitled "Soils Testing".

D. TOPSOILING

D.1 Scope

The work under this section includes the furnishing of all labor, equipment, materials, and the performing of all operations in connection with furnishing, placing, and grading topsoil over the compacted final cover surface.

D.2 Materials

Material for topsoil shall be natural surface soil, friable and loamy, free of debris, stumps, brush, litter, and stones larger than three (3) inches in diameter. The topsoil shall not contain toxic substances that may be harmful to plant growth. A pH range of 5.0 to 7.5 is acceptable. Topsoil shall have a minimum organic content of 2.75%. Prior to topsoil placement, the contractor shall test one representative sample of each source of material for acidity and organic content, as described in Appendix I-2, "Construction Quality Assurance and Quality Control Plan".

D.3 Placement and Grading

Topsoil shall be placed over the compacted final cover soils within the limits shown on the drawings and shall be evenly and smoothly spread over the surface. Topsoil shall be placed so that the total thickness is not less than twelve (12) inches after firming. Topsoil shall not be placed while in a frozen or muddy condition or when the final cover is excessively wet and soft or in a condition that may otherwise be detrimental to proper grading.

E. SEEDING AND EROSION CONTROL

E.1 Scope

The work included in this section includes the fumishing of all labor, equipment and materials, and in performing all operations in connection with the application of lime or sulfur, seeding, fertilizing, and mulching, of the area indicated on the drawings, completed and accepted, in accordance with the specifications and drawings.

E.2 Materials

E.2.1 Lime

Lime shall be agricultural ground dolomitic limestone conforming to the standards of the Association of Official Agricultural Chemists, and complying with all existing State and Federal Regulations. The materials must comply with the following gradation:

Square Mesh Sieves	% Passing by Weight
Pass #10	100
Pass #20	90
Pass #200	50

The minimum calcium carbonate equivalent shall be 90% by weight. The Owner reserves the right to draw such samples and to perform such tests as the Owner deems necessary to assure that these specifications are met.

E.2.2 Sulfur

Sulfur shall be commercial flour sulfur, unadulterated, and shall be delivered to the site in the original unopened containers or in bulk lots with the name of the manufacturer, material analysis and net weight specified.

E.2.3 Fertilizer

Fertilizer shall be a complete fertilizer containing 10% nitrogen, 20% potash, and 10% phosphorous and referred to as 10-20-10. The total nitrogen content shall either be derived from natural organic sources or be a urea-form fertilizer. The commercial fertilizer shall be delivered to the site in the original unopened containers which shall bear the guaranteed statement of analysis of the manufacturer.

E.2.4 Seed Mixture

The seed mixture shall be delivered to the site in new, clean, sealed containers. Labels and contents shall conform to all State and Federal regulations. Seed shall be subject to the testing procedures of the Association of Official Seed Analysts. The seed shall be delivered to the site accompanied by a properly executed certificate from the supplier of each type of seed attesting to its freshness, components, proportion (if mixed), minimum purity, and minimum germination. The seed quality and certificates are subject to approval by the Owner prior to their being applied. Acceptable seed types and application rates include:

Seed Name	Application Rate
Bermuda Grass (cynodon dactylon)	7 lbs/acre
Annual Ryegrass (lolium multiflorum)	20 lbs/acre

E.2.5 Straw

Straw shall be small-grain straw or hay. As necessary, a liquid mulch binder such as emulsified asphalt, cutback asphalt, or synthetic or organic binders shall be used at the rates recommended by the manufacturer.

E.2.6 Water

Water used in this work will be furnished by the Owner and will be suitable for irrigation and free from oil, acid, alkali, salt and other substances harmful to plant life. The Contractor will provide all equipment including hose necessary to apply the irrigation water.

E.3 Season of Seeding

The preferred dates for seeding are May 1 to July 1. If these dates are missed, then alternate dates are August 1 to November 15.

E.4 Application

E.4.1 Application of Lime or Sulfur

Lime or sulfer shall be applied at rates determined by the Owner based on tests of the topsoil material, as described at D.2. When applied dry, the limestone or sulfur shall be spread evenly and then thoroughly incorporated into the top three (3) inches of the soil by approved means and shall produce a roughened seedbed. When applied hydraulically, no discing will be necessary.

E.4.2 Application of Fertilizer and Seed

The preferred method of applying fertilizer and seed shall be hydraulic, however, any agronomically acceptable and reasonable method of uniformly applying the seed and/or the fertilizer separately or together may be utilized that is approved by the Owner. The Owner shall reserve the right to temporarily halt any seeding operation during the presence of strong winds. Fertilizer shall be applied at the rate of 500 lbs per acre. Seed shall be applied at the rates recommended by the Supplier(s), subject to Owner-approval.

E.4.3 Application of Mulch

The straw mulch shall be applied hydraulically or by hand, at the rate of 2-2.5 tons per acre. As necessary, straw mulch shall be coated with a liquid mulch binder in accordance with the manufacturer's recommendations. Mulching shall be performed as a separate operation.

E.5 Maintenance

E.5.1 The Contractor

The Contractor shall be required to replant, using full amounts of all specified materials and all of the complimentary procedures, those areas damaged by wind, fire, erosion, equipment, or pedestrian traffic during the life of the contract, to the satisfaction of the Owner.

E.5.2 The Contractor

The Contractor shall be required to clean up and remove all debris resulting from the seeding operations on roads and other areas within and adjacent to the project.

F.4 Testing Schedule

A. Prior to the acceptance of any materials from any on-site or off-site source for any purpose, the Contractor shall arrange for a sufficient number of tests deemed acceptable by the Engineer to be accomplished in the testing laboratory to establish the following engineering characteristics of granular and cohesive materials:

1) Particle Size Analysis of Soils - ASTM D 1556

2) Amount of Materials in Soils finer than No. 200 Sieve - ASTM D 1140

3) Liquid Limit of Soils - ASTM D 423

4) Plastic Limit and Plasticity Index of Soils - ASTM D 424

5) Moisture Content of Soil - ASTM D 2216

6) Moisture - Density Relations of Soils - ASTM D 698

7) Permeability Test for Clay Liner in Cap System - Illinois EPA Method

Laboratory determination of permeability of fine grained soils shall be performed using the modified triaxial apparatus technique, including backpressure saturation, to determine the constant head, saturated permeability of "undisturbed" soil samples. Disturbance of the soil sample shall be minimized both before and durifng the determination in order to approximate actual field conditions. The permeant liquid shall be either tap water or a 0.005 N $CaSO_4$ solution. In any case, distilled water shall not be used. The effective stress (confining cell pressure minus the average of the headwater and tailwater pressures) applied to the soil sample in the triaxial apparatus shall be set as close as possible to the expected in situ-stress conditions to prevent excessive consolidation of the soil sample.

Laboratory permeability determination reports shall include a detailed description of both the sample collection and preparation techniques and the details (cell pressure, headwater pressure, tailwater pressure, driving pressure, gradient, sample size, permeant liquid, time, etc.) of the determination procedures. Tests shall be performed in two phases as specified below.

Phase I: Collect and prepare a sample and backpressure saturate. Subject the sample to a constant hydraulic gradient (driving force pressure expressed in centimeters of water divided by length of sample in centimeters) of less than 20 until the volume of permeant flowing out of the sample in a minimum period of three (3) hours is equal to the volume input in the same period. Compute the permeability at the conclusion of the steady state period.

Phase II: Prepare an identical sample and backpressure saturate. Subject the sample to a constant hydraulic gradient not exceeding 300. This gradient shall be maintained until at least two (2) pore volumes of permeant liquid have passed through this soil sample. Readings shall be taken and permeability computed at the lesser interval of 0.25 pore-volume or 24-hours. The results shall be plotted on an arithmetic scale to show permeability versus pore volume. If the measured permeability is relatively constant or decreases with the number of pore volumes passed through the sample, then it can be concluded that the permeant does not alter the soil skeleton so as to increase the specimen permeability from the Phase I test. However, should the measured permeability show an increasing trend, the procedure required for liners must be performed on that soil type to determine the sample's permeability.

B. A sufficient number of tests shall be accomplished upon samples of the cohesive clay or silt (CL or CH) proposed to be furnished for use in the cap to determine the most practical combination of densities and moisture contents to assure an in-place coefficient of permeability of not more than 1 x 10^{-7} cm/sec.

C. After materials from either on-site or off-site sources have been approved for use in the Cap on the project, a sufficient number of representative samples of the materials being placed shall be tested to insure that their properties are consistent with those established when approving these materials. The minimum numbers of both tests on Silt and Clay provided as the clay layer in the Cap materials are as follows:

1) At least one test per 1,000 cubic yards being placed:

a) Particle Size of Analysis of Soils

b) Materials finer than No. 200 Sieve

2) At least one test per 250 cubic yards being placed:

   a) Density (including Moisture Content) of soil in place by one of the following materials:

      Rubber-Balloon Method - A55M D 2167
      Sand-Cover Method - ASTM D1556
      Nuclear Method - D 2922/D 3217

3) At least one test per 5,000 yards being placed:

   a) Liquid Limit of Soils

   b) Plastic Limit and Plasticity Index of Soils

Justification for the sampling frequences is provided in the attached Table 1.

TABLE 1

Testing Frequencies

Recommendations for Construction Documentation of Clay-Lined Landfills by the Wisconsin Department of Natural Resources

Item	Testing	Frequency
1. Clay borrow source testing	Grain size	1,000 yd^3
	Moisture content	1,000 yd^3
	Atterberg limits (liquid limit and plasticity index)	5,000 yd^3
	Moisture-density curve	5,000 yd^3 and all changes in material
	Lab permeability (remolded samples)	10,000 yd^3
2 Clay liner testing during construction	Density (nuclear or sand cone)	5 tests/acre/lift (250 yd^3)
	Moisture content	5 tests/acre/lift (250 yd^3)
	Undisturbed permeability	1 test/acre/lift (1,500 yd^3)
	Dry density (undisturbed sample)	1 test/acre/lift (1,500 yd^3)
	Moisture content (undisturbed sample)	1 test/acre/lift (1,500 yd^3)
	Atterberg limits (liquid limit and plasticity index)	1 test/acre/lift (1,500 yd^3)
	Grain size (to the 2-micron particle size)	1 test/acre/lift (1,500 yd^3)
	Moisture-density curve (as per clay borrow requirements)	5,000 yd^3 and all changes in material
3. Granular drainage blanket testing	Grain size (to the No. 200 sieve)	1,500 yd^3
	Permeability	3,000 yd^3
Source: Gordon et al., 1984.		

I-2 CONSTRUCTION QUALITY ASSURANCE AND QUALITY CONTROL PLAN

1 Quality Assurance Organization and Responsibilities

The Owner will have ultimate responsibility for activities undertaken at the site, including responsibility for overseeing construction. A qualified construction firm will be selected for this project. The Owner or his Engineer will provide guidance to the selected firm during construction. an independent registered professional engineer in the State of Illinois will provide inspections, as necessary, to ensure that construction of the final cover is conducted within prudent engineering principals. The independent professional engineer will then certify the construction of the final cover. Figure 1 depicts the organizational chart for this construction project.

<u>Owner</u>

The Owner will have the ultimate responsibility for the construction of the final cover. The Owner has the authority to commit the necessary resources to accomplish closure. The Owner will be kept apprised of progress and situations involved with closure by his Engineer. The Owner will inform IEPA when closure activities begin and are completed.

<u>Contracted Construction Firm</u>

A qualified construction firm will be retained by the Owner to accomplish closure. The firm will be managed by competent individuals who have had prior experience with these types of construction operations. The firm will follow construction designs and specifications that will be developed and approved for the closure activities.

<u>Owner's Engineer</u>

The Owner's Engineer will act as liaison between the Owner and the construction firm. He shall coordinate all construction activities with the contracted firm and immediately report any problems or deviations from designed construction operations to the Owner. He will be involved in the day-to-day management of construction activities at the closure site.

Owner's Inspector

The Owner's Inspector shall observe the daily construction activities of the final cover. He will immediately report any problems or deviations from design specifications or drawings to the Owner's Engineer. The inspector will collect the required number of samples needed to ensure the final cover has met all the design standards and ship them to a laboratory certified to conduct soil analysis.

Laboratory

The laboratory will analyze all soil samples according to the ASTM methods stipulated in the next section of this QA/QC Plan. The laboratory will be staffed with professionals experienced in soil analysis and shall be certified to conduct ASTM analysis.

Registered Professional Engineer

An independent registered professional engineer will inspect closure activities to ensure that closure has been conducted pursuant to 35 Ill. Adm. Code 725.410 requirements. The engineer will certify and seal all certification documentation and send such documentation to the IEPA after closure activities are completed.

0.1 Closure Construction Testing Protocol

Soil Source Acceptance

The contractor will test each offsite source of backfill, clay cover, and topsoil that is proposed to be used in the cover system. The following test results will be submitted to the Owner before acceptance of any soil material:

- Backfill testing for moisture-density relationship.
- Clay cover testing for moisture content, grain size distribution, specific gravity, liquid and plastic limits, moisture-density relationship, and hydraulic conductivities at 85, 90, and 95 percent of standard Proctor maximum dry density at various moisture contents.
- Topsoil testing for acidity and organic content.

The soils shall be tested by an ASTM-certified laboratory, which shall provide QA/QC documentation on procedures and calibration. The allowable test methods and acceptance criteria are provided in Table 1. The Owner's Inspector will sample each initially accepted material and repeat the above analyses prior to final acceptance and use of any of the materials

TABLE 1

Soil Acceptance Test Methods and Criteria

Parameter	Test Method	Acceptance Criteria
Moisture-Density Relationship	ASTM D-698	None*
Moisture Content	ASTM D-2216	None*
Grain Size Distribution	ASTM D-422	100% finer than 0.75 inch, 30% finer than No. 200
Specific Gravity	ASTM D-854	None
Liquid/Plastic Limits	ASTM D-4318	Liquid Limit >30% Plasticity
Hydraulic Conductivity	ASTM D-2434	index $\geq 10^{-7}$ cm/sec
Acidity		pH = 5.0 - 7.5
Organic Content		O.C. ≥2.75%

*No limits, but test must conclusively show material characteristics to the satisfactino of the Owner's Engineer.

in onsite construction. Sampling and analysis may be repeated at any time during construction, and material acceptance may be suspended or revoked based on such tests.

Constructed Cover Acceptance

The Owner's Inspector will perform in-place density tests on constructed sections of backfill and clay final cover, to verify proper compaction and minimum permeabilities. Test methods, frequencies, and acceptance criteria are provided in Table 2. Tested sections failing acceptance criteria will be reworked, or removed and replaced, by the contractor until meeting such criteria.

2. Recordkeeping

All construction and sampling activities will be documented by the Owner's Engineer. The documentation will be in the form of field records and will contain all activities conducted during construction, including any deviance from design plans and specification. Any physical anomaly that may affect the construction of the final cover will be denoted as well (i.e., weather). A copy of the field record will be submitted to IEPA with the closure certification documents. The original field records will be archived by the Owner until the end of post-closure care.

TABLE 2

Constructed Cover In-Place Test Methods and Acceptance Criteria

Parameter	Frequency	Test Method	Acceptance Criteria
Backfill Density	1/lift/day	ASTM D-2922	90% of maximum dry density
Clay Cover Density	1/lift/day	ASTM D-2922	In range to provide H.C. <10^{-7} cm/sec.

Appendix 4:
Certification Regarding Releases from Solid Waste Management Units

ATTACHMENT 1

CONTINUING RELEASES AT PERMITTED FACILITIES

Sec. 206. Section 3004 of the Solid Waste Disposal Act is amended by adding the following new subsection after subsection (t) thereof: "(u) CONTINUING RELEASES AT PERMITTED FACILITIES-Standards promulgated under this section shall require, and a permit issued after the date of enactment of the Hazardous and Solid Waste Amendments of 1984 by the Administrator or a State shall require, corrective action for all releases of hazardous waste or constituents from any solid waste management unit at a treatment, storage, or disposal facility seeking a permit under this subtitle, regardless of the time at which waste was placed in such unit. Permits issued under section 3005 shall contain schedules of compliance for such corrective action (where such corrective action cannot be completed prior to issuance of the permit and assurance of financial responsibility for completing such corrective action".

ATTACHMENT 2

INTERIM STATUS CORRECTIVE ACTION ORDERS

Sec. 223. (a) Section 3008 of the Solid Waste Disposal Act is amended by adding the following new subsection after subsection (g) thereof:
"(h) INTERIM STATUS CORRECTIVE ACTION ORDERS. - (1) Whenever on the basis of any information the Administrator determines that there is or has been a release of hazardous waste into the environment from a facility authorized to operate under section 3005(e) of this subtitle, the Administrator may issue an order requiring corrective action or such other response measure as he deems necessary to protect human health or the environment or the Administrator may commence a civil action in the United States district court in the district in which the facility is located for appropriate relief, including a temporary or permanent injunction.

"(2) Any order issued under this subsection may include a suspension or revocation of authorization to operate under Section 3005(e) of this subtitle, shall state with reasonable specificity the nature of the required corrective action or other response measure, and shall specify a time for compliance. If any person named in an order fails to comply with the order, the Administrator may assess, and such person shall be liable to the United States for, a civil penalty in an amount not to exceed $25,000 for each day of noncompliance with the order."
(b) Subsection (b) of section 3008 of the Solid Waste Disposal Act is amended by inserting "issued under this section" immediately after "Any Order".

ATTACHMENT 3

CERTIFICATION REGARDING POTENTIAL RELEASES FROM SOLID WASTE MANAGEMENT UNITS (CLOSURE PLAN REVIEW)

FACILITY NAME: CHEMETCO, INC.

EPA I.D. NUMBER: ILD048843809 Ill # 1198010003

LOCATION/CITY: Hartford

STATE: IL

1. Are there any of the follwoing solid waste management units (existing or closed) at your facility? NOTE - DO NOT INCLUDE HAZARDOUS WASTES UNITS CURRENTLY SHOWN IN YOUR PART A APPLICATION AND IN YOUR CLOSURE PLAN.

	YES	NO
• Landfill		✓
• Surface Impoundment		✓
• Land Farm		✓
• Waste Pile		✓
• Incinerator		✓
• Storage Tank (Above Ground)		✓
• Storage Tank (Underground)		✓
• Container Storage Area		✓
• Injection Wells		✓
• Wastewater Treatment Units		✓
• Transfer Stations		✓
• Waste Recycling Operations		✓
• Waste Treatement, Detoxification		✓
• Other ______		✓

2. If there are "Yes" answers to any of the items in Number 1 above, please provide a description of the wastes that were stored, treated or disposed of in each unit. In particular, please focus on whether or not the wastes would be considered as hazardous wastes or hazardous constituents under RCRA. Also include any available data on quantities or volume of wastes disposed of and the dates of disposal. Please also provide a description of each unit and include capacity, dimensions, location at facility, provide a site plan if available.

NOTE: Hazardous waste are those identified in 40 CFR 261. Hazardous constituents are those listed in Appendix VIII of 40 CFR Part 261.

3. For the units noted in Number 1 above and also those hazardous waste units in your Part A application and in your closure plan, please describe for each unit any data available on any prior or current releases of hazardous wastes or constituents to the environment that may have occurred in the part or still be occurring.

Please provide the following information

a. Date of release
b. Type of waste released
c. Quantity or volume of waste released
d. Describe nature of release (i.e., spill, overflow, ruptured pipe or tank, etc.)

a: September 1996 b: Zinc oxide c: 3,000-5,000 cubic yards

d: spill from former stormwater pipe.

~~Unit will be going through RCRA closure, will be added to Part A when the closure plan is submitted.~~

4. In regard to the prior releases described in Number 3 above, please provide (for each unit) any analytical data that may be available which would describe the nature and extent of environmental contamination that exists as a result of such releases. Please focus on concentrations of hazardous wastes or constituents present in contaminated soil or groundwater.

~~Data is still being gathered. All data will be included in~~ the closure plan to be submitted for the zinc oxide spill area

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the submital is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations. (42 U.S.C. 6902 et seq. and 40 CFR 270.11(d))

David Hoff, President
Typed Name and Title

David A Hoff
Signature

February 25, 1997
Date

Appendix 5: LPC Form -PA19
Signature & Certifications

RCRA INTERIM STATUS CLOSURE AND POST-CLOSURE
CARE PLANS GENERAL FORM
LPC-PA18

THIS FORM MUST ACCOMPANY ANY RCRA INTERIM-STATUS CLOSURE AND/OR POST-CLOSURE CARE PLANS OR MODIFICATION REQUEST SUBMITTED TO THE DIVISION OF LAND POLLUTION CONTROL. THE ORIGINAL AND TWO COPIES OF ALL DOCUMENTS SUBMITTED MUST BE PROVIDED.

FACILITY IDENTIFICATION (Information about the facility where the units are located which are addressed in this closure plan)

Name: Chemetco, Inc
County: Madison
Street Address: Route 3
Site # (IEPA): 1 1 9 8 0 1 0 0 0 3
City: Hartford
Site No. (USEPA): I L D 0 4 8 8 4 3 8 0 9

OWNER INFORMATION		OPERATOR INFORMATION
Name:	Chemetco, Inc.	Same as owner
Mailing Address:	P.O. Box 67	
	Hartford, IL 62048	
Contact Name:	Greg Cotter	
Contact Title:	Environmental Manager	
Phone #:	618/254-4381	

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PERMIT SECTION

TYPE OF SUBMISSION (check applicable item and provide requested information, as applicable)

X Original (New) Closure Plan
___ Original (New) Post-Closure Plan
___ Response to Disapproval letter
___ Modification Request
___ Additional Information for ___ / ___ / ___ Submittal (Log No. ______ if known)

Log No. of Most Recent Agency Approval/Disapproval Letter ______

Date of Most Recent Agency Approval/Disapproval Letter ______

DESCRIPTION OF SUBMITTAL: (briefly describe what is being submitted)

Zinc Oxide Bunker closure plan and contingent closure/post closure plan

LIST OF DOCUMENTS SUBMITTED (identify all documents in this submittal, including the cover letter)

Interim Status Closure and Contingent Closure Post Closure Plans for the Zinc Oxide Bunker dated February 21, 1997

UNITS UNDERGOING CLOSURE (please identify what type of units are addressed in the plan, their capacities and whether they are on the RCRA Part A for the facility)

Unit	Unit Code	Number of Units Closing	Capacity	On Part A (Y/N)
Storage:				
Container (barrel, drum, etc.)	S01			
Tank	S02			
Waste Pile	S03	1	3 MG	Y
Surface Impoundment	S04			

UNITS UNDERGOING CLOSURE (continued)

Unit	Unit Code	Number of Units Closing	Capacity	On Part A (Y/N)
Treatment:				
Tank	T01			
Surface Impoundment	T02			
Incinerator	T03			
Other (explain)	T04			
Disposal:				
Landfill	D80			
Land Application	D81			
Surface Impoundment	D83			

CERTIFICATION AND SIGNATURE (Must be completed for all submittals. Certification and signature requirements are set forth in 35 IAC 702.126. Any submittal involving engineering plans, specifications and calculations as defined in the Illinois Professional Engineering Act and 68 IAC 1380 must be signed and certified by an Illinois registered professional.)

All closure plans, post-closure plans and modifications must be signed by the person designated below or by a duly authorized representative of that person:

Corporation - By a principal executive officer of at least the level of vice-president.
Partnership or Sole Proprietorship - By a general partner or the proprietor, respectively.
Government - By either a principal executive officer or a ranking elected official.

A person is a duly authorized representative only if:

1. the authorization is made in writing by a person described above; and
2. is submitted with this application (a copy of a previously submitted authorization can be used).

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Owner Signature: David A. [illegible] ______ (Date)

Title: President

Operator Signature: Same ______ (Date)

Title: ______

Engineer Signature: ______ (Date)
(if necessary)

Engineer Name: ______ Engineer Seal:

Engineer Address: ______

Engineer Phone No.: ______

JM:sf/sp/1243r,1-2

This Agency is authorized to require this information under Illinois Revised Statutes, 1979, Chapter 111 1/2, Section 1039. Disclosure of this information is required under that Section. Failure to do so may prevent this form from being processed and could result in your application being denied. This form has been approved by the Forms Management Center